Mortality levels, patterns and differentials and their correlates in the pre-development context: the case of Lao PDR

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A thesis submitted for the degree of
Doctor of Philosophy
Demography Program
Division of Demography and Sociology
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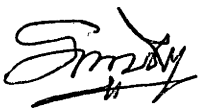
June, 1999

Declaration

Except where otherwise indicated, this thesis is my own work undertaken as a scholar in the Demography Program, Division of Demography and Sociology, Research School of Social Sciences, the Australian National University.



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Canberra, June 1999

Acknowledgements

I wish to thank the Australian Agency for International Development (AusAID) for granting me financial support to undertake my PhD work in demography at the Australian National University. My sincere thanks also extend to the United Nations Population Fund (UNFPA) which provided me with funding for pursuing my post-graduate study in Australia, especially Dr J. S. Parsons who gave me strong support and introduced me to this subject in the first place. I am grateful to the people of Lao PDR who entrust me with this prestigious assignment of bringing home knowledge and skills to contribute to the economic and social development of Laos.

I am deeply indebted to my panel comprised of Prof. Geoffrey McNicoll as the chair, Dr Heather Booth and Prof. Peter McDonald, who vigorously gave me guidance and encouragement. These people tirelessly pulled me through difficult times and provided me with helpful comments and input into the development of this thesis. Without their help my work would not have achieved its goals. I wish to thank my former panel Dr Habtemariam Tesfaghiorghis and Dr ChingChoi who gave me constructive comments on analytical methods during the commencement of my work. My special thanks to all the staff and students of the Demography Program, Research School of Social Sciences, the Australian National University who made my work and stay in Australia enjoyable and fruitful.

I would like to thank Ms Karen Ewens, Ms Diana Crow, Ms Jenny White, Ms Ann Evans, Ms Milisa Haberschuzs and Ms Kay Nantes for their technical and administrative assistance. My special thanks also go to Mrs Helen Richmond and Ms Lynn Toohey, AusAID liaison officers for their attention and care for my health and research.

I wish to thank Prof. Peter Warr of the Economic Department, Research School of Pacific and Asian Studies and Prof. Gavin Jones, Dr Terry Hull, Dr Chris Wilson, Dr David Lucas and Dr Chris McMurray of the Demography Program for giving emotional support and motivation.

I am certainly indebted to all staff members of the National Statistical Centre (NSC), State Planning Committee, Vientiane, especially Mr Bounthavy Sisouphanthong, the Director, Ms Sudachanh, Ms Phonesaly and Mr Bouangeun for their generous assistance during my field work at the NSC.

Above all I dedicate this work to my beloved mother and father, my wife, Sommay, my daughter and son, Mayurat and Khomphat, who made priceless sacrifice for the success of my work.

Abstract

Until recently Lao PDR (Laos) has lacked mortality data for use in planning and social analysis. Mortality estimates came mostly from indirect estimation techniques and were mainly confined to infant mortality rates. Adult mortality was largely neglected. Although it was estimated that mortality in Laos is among the highest in the world, no comprehensive study of mortality and its correlates has been undertaken for Laos.

This study made use of newly available data from nationally representative surveys on adult, infant and child mortality to investigate the patterns and differentials in adult mortality, and to examine the levels, differentials and determinants of infant and child mortality. This allowed the calculation of first national life tables by sex. The 1989-91 Multi-round Vital Statistics Survey (MVSS) is used for the adult mortality estimation while the 1994 Fertility and Birth Spacing Survey is the basis of infant and child mortality estimates.

This study first assesses the quality of the MVSS to determine errors in coverage of the population and deaths and identify data inconsistencies and other non-sampling errors. It then evaluates age-sex reporting of the population, and derives age-specific death rates by sex for national population and subgroups using direct methods of estimation.

It is found that young adult male mortality is very high, and this is probably linked to high incidence of work-related hazards and accidents. At the same time, mortality among adult females is high during reproductive ages reflecting high maternal mortality due to the general lack of maternity clinics. Laos has high fertility and close birth intervals and about 90 per cent of Lao women give birth at home. Adult mortality differentials across population subgroups can be clearly identified only from ages 5 to

39. At ages 40 and above, differential mortality is less clear. Mortality is higher among people living at high altitudes and practicing slash-and-burn cultivation, among populations in regions other than the central region of the country, among rural populations and among people belonging to ethnic minorities. This clearly indicates that mortality is linked to level of development, elevation, food security and cultural factors such as health beliefs and health seeking behaviour, access to health care and sanitation, housing and food habits.

Life table survival analysis is employed to estimate infant and child mortality levels and differentials, while Cox regression is used for study of determinants of infant and child mortality. Infant and child mortality has declined over time, especially during the period from 1975-89, but is still very high. Mother's age at childbirth and birth order are strongly correlated with infant and child mortality. Among socio-economic covariates, maternal education is the strongest determinant of mortality followed by urban or rural residence, paternal education and father's occupation. Multivariate analysis indicates that occupation of mothers and regions of residence are not statistically significant determinants of infant and child mortality. Overall, morality is higher for males than for females.

This study analyzed the context of such mortality findings and suggests the most likely reasons for the prevailing high mortality regime is the underdevelopment of economic and transport infrastructure, food insecurity, the lack of preventive health care and of access to health care for the general population. If Laos improves health care services for all segments of the population mortality can be expected to fall. This is a challenge that has eluded governments in the past, but it must be met if Lao children are to have a better future.

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Chapter 1

Introduction

1.1. The study of mortality in Lao People's Democratic Republic

While the world advances towards the new millennium with tremendous achievements in many areas, particularly in the information and computer technologies, hundreds of millions of people in the Third World are still living in absolute poverty and precarious health conditions (World Bank, 1990; Singer, 1993). The majority of the population in the least developed countries still do not have access to safe drinking water, electricity, education, adequate nutrition and health care, and transportation (World Bank, 1990).

Development in Lao People's Democratic Republic (Lao PDR or generally known as Laos) has begun recently, following the end of Indochina war, with social development still lagging behind economic development (World Bank, 1995b). The mortality situation of its population echoes that of the developed world more than a century ago. In most of the world mortality experienced a rapid decline following the end of the Second World War (UN, 1982). In Lao PDR, however, mortality and fertility continue stand at very high levels (SSC, 1986, NSC/LWU, 1995).

It is widely accepted that mortality rates, particularly infant and child mortality, are useful indicators of the health situation and living conditions of a population (McDonald, 1982; UN, 1982; Ruzicka and Kane, 1990). Numerous studies have explored how mortality levels are influenced by social, economic and biological factors

(UN, 1982; Schofield, 1984). Inevitably, there factors are inter-related: their interactive effects emerge not only in the analysis of mortality, but also in the assessment and evaluation of the impact of health care and other interventions (Ruzicka and Kane, 1986:35).

Like the situation in some other developing countries, until quite recently demographic information for Lao PDR hardly existed. Vital registration is too incomplete to provide a source for reliable and regular death statistics or information on causes of death. There is even less information to support refined mortality rates, mortality determinants and mortality differentials among the population subgroups of Lao PDR.

The mortality estimates for the country that were available from various sources were often conflicting and of doubtful value, often apparently not based on empirical data. Policy makers were not able to assess health problems in Lao PDR, or to design appropriate intervention measures. The result was that insufficient resources were allocated to public health and health intervention programs and spending was directed towards expensive-hospital-based therapeutic measures rather than prevention (UNICEF, 1992; 1996). Information on factors influencing health and mortality which might have enhanced the efficiency of the formulation and implementation of public health program was simply absent. Health policies and programs were formulated in a uniform manner without regard to the regional, social class and ethnic diversity of the potential beneficiaries. This was partly due to the lack of knowledge of the differentials and determinants of mortality for the country.

Differentials in mortality are expected to be particularly pronounced for infant and child mortality in the case of Lao PDR with its great variety of ethnicity, culture, traditions and norms, and large regional variation in the degree of development.

Evidence from studies covering a wide range of societies at different levels of overall mortality shows that there is a direct association between infant and child mortality and a range of indices of economic and social resources available to the family (Ruzicka and Hansluwka, 1982: 104; Ruzicka, 1989). This relationship holds even for population subgroups such as population by geographic subdivision, including urban or rural subdivisions (Ruzicka, 1989). It has been shown that over time, despite any general decline of mortality, the differences in the chances of child survival among various socio-economic subgroups of the national population persist (Ruzicka, 1989: 3, Cleland et al., 1992).

However, no comprehensive study on mortality differentials over various population subgroups and on infant and child mortality determinants has so far been undertaken for Lao PDR. A sound understanding of the interacting and correlated risk factors underlying mortality forces and causes of death prevailing in the country, particularly with respect to infant and child mortality which is very high in Lao PDR, is necessary to throw light on the health problems and to assist health planners to work out appropriate policies and measures to improve the health status of the population.

Poor condition of roads and transport infrastructure is a major problem for development in Lao PDR. The majority of the population at low densities across difficult terrain, and most of the institutions for implementing government programs and projects are weak and inefficient. Hence different segments and subgroups of the population have reached different degrees of development. Ruzicka and Kane (1990: 6) argue that the association between mortality and development is dominated by different forces at different stages and levels of development. Such differentials may well be found in the Lao population. Knowledge of the mortality levels, patterns and differentials, and an understanding of their correlates in this subsistence agrarian

economy would pave the way to better policy formulation and better health care and other social services.

This chapter begins with a discussion of the theoretical background of mortality transition and differentials, a literature review of mortality studies in Lao PDR and a statement of research problem. The sections that follow discuss the context under which the mortality situation will be studied. The chapter concludes with an outline of the thesis.

1.2. Theoretical review of mortality transition and differentials

Mortality has traced a path from a high level to low level in most parts of the world, but remains high in some countries. The mortality transition is best described by the changing pattern of diseases through which mankind lives. Changes in human mortality can be viewed in terms of the epidemiological transition theory (Omran, 1971) which comprises five propositions. These are: 1) mortality is a fundamental factor in population dynamics; 2) during the transition, a long term shift occurs in mortality and disease patterns whereby degenerative and human-made diseases progressively but not totally replace pandemics of infection as the leading causes of death; 3) the improvements in survivorship that occur with the recession of pandemics tend to benefit females in the reproductive age groups rather than males; 4) the shifts in health and disease patterns that characterized the epidemiological transition before the twentieth century have a closer association with rising standards of living and improved nutrition than with medical progress; and 5) distinctive variations in the pattern, the pace, the determinants, and the consequences of population change differentiate four basic models of the epidemiological transition, i.e., the classical or western model, the accelerated variant of the classical model, the delayed model, and the transition variant of the delayed model.

The classical or western model describes the transition of mortality from high death rates to low death rates which took place over the past 200 years in western societies. In this model, mortality declined gradually in response to improvements in social, economic and environmental conditions including improved nutrition and personal health habits. Mortality transition in the accelerated variant of the classical model is a transition over a shorter period of time. This model describes the transition in Japan, and Eastern European countries including the former USSR. Changes in mortality that have been observed in most developing countries are described by the delayed model. There, mortality has declined dramatically since the end of the World War II, while fertility remains at high levels. The mortality transition observed in certain developing countries such in East Asian countries and Singapore can be described by the transitional variant of the delayed model.

With regard to mortality decline in Europe, Schofield and Reher identify three distinctive phases. The first phase was during the eighteenth century when the incidence of crisis mortality diminished drastically in most of Europe. The second phase was the period of the reduction of epidemics when endemic infectious diseases became relatively more important and gains in life expectancy slowed considerably. It was not until the latter part of the nineteenth century that mortality once again declined sharply in most areas of Europe. The third phase of mortality decline begun after World War II and spread throughout the world. It seems inextricably, though not exclusively, linked to the use of sulpha drugs and antibiotics (Schofield and Reher, 1991: 1).

Essentially, the classical mortality transition theory could be summed up by saying that economic development and structural change in pre-industrial European economies brought about mortality decline followed by a decline in fertility. In contrast, the mortality decline observed in most of the developing world is mainly the effect of

imported medicines and the implementation of western health care systems. However, the causal relationships between mortality decline in the developing world and other socio-economic factors are far from uniform and not readily summarized (Arriaga and Davis, 1965; Omran, 1971; Caldwell, 1986; Palloni, 1990; Ruzicka and Kane , 1990).

For quite some time mortality and the factors correlated with its decline in the low-income developing countries have been the focus of studies carried out by various researchers. The findings vary in different contexts. However, general guidelines for the investigation of the factors behind mortality and its decline can be drawn from these studies. Various conclusions have been reached by Gwatkin (1980) in his study of the change in mortality trends in developing countries, by Ruzicka and Hansluwka (1982) in their studies of mortality transition in South and East Asia , and by Ruzicka and Kane (1986) in their assessment of the effects of the socioeconomic changes on mortality decline in selected countries of the ESCAP region. One of the conclusions reached by these authors is that sustained mortality decline could not be achieved in developing countries in the face of only limited improvements or even retrogression in the economic growth and living standards. As just noted that the rapid decline in mortality in developing countries have been the result of the health programs to control infectious and communicable diseases. Nevertheless, the increased availability of food supplies and other socio-economic changes also play an important role in the decline (McKeown et al,. 1975; McKeown, 1976; Hull and Jones, 1986:1). According to Stolnitz (1989), the explanations of mortality decline must refer to both sets of causal factors: socio-economic factors and health-related progresses including improved sanitation.

The causes of mortality decline are a source of ongoing controversy. Caldwell (1990) has argued that, in contrast with western countries, there is a link between social and cultural factors and mortality transition in developing countries. Nevertheless, even

when education and income are controlled, major cultural and ethnic differentials still exist (Caldwell, 1990: 44-59). Similar conclusions are reached by Mensch et al. (1983) and Defo (1993) in their studies of mortality differentials in African countries.

Other studies on factors related to mortality and morbidity decline in developing countries of Africa, Latin American and Asia by Caldwell (1979), Cochrane, (1980), Meegama, (1980); McDonald (1982), Mosley (1983), Jain (1984), Hobcraft et al. (1984), United Nations (1985), Palloni (1985), Caldwell (1990), Caldwell and Caldwell (1991), among others, have found that parental education, especially maternal education, is an important factor among social and economic characteristics of individuals and households leading to lower mortality. Children's probability of dying is inversely related to mother's years of schooling; although there may be several other factors at work, maternal education is one of the strongest socio-economic factors associated with child survival (Hobcraft et al., 1984; Cleland and van Ginneken, 1989; Cleland, 1990; Kent, 1991). Caldwell (1986, 1990), suggested that social determinants play the key roles as predictors of the levels of mortality in the third world countries whereas levels of income and health services are weak predictors. Maternal education has multiplicative effects at both the individual family and societal levels.

It does not seem that the implementation of modern health systems without progress in socio-economic development and improvement in basic needs would bring mortality the levels in developing world down to the level enjoyed by the developed industrial countries. At the beginning of the century, there is clear evidence of the inverse relationship between levels of socio-economic development and general mortality in different countries of the world. In the course of time that association is weakened considerably (Preston, 1975), since the rapid decline in mortality in developing countries is largely due to technological advances in the prevention and

control of diseases and to the spread of medical and public health services which to a great extent, are not related to the economic conditions of the region (Ruzicka and Hansluwka, 1982). However, Hill and Pebley (1989) found that there are differences in the pace of mortality decline among different regions and countries depending on the initial mortality levels, and that the effects of the deterioration in economic conditions on the general slowdown in the pace of mortality decline in the early 1980s are contrary to what might be expected (Hill and Pebley, 1989: 680-81).

As noted earlier, levels of income and health services are not strong predictors of mortality outcomes in the developing world (Caldwell, 1990). This may be because income and health services themselves are influenced by other socio-economic and cultural factors, such resource endowments, and because access to health care is influenced by the state of roads and transportation, by health beliefs and health seeking behaviour, and by customs and traditional practices.

Therefore, although epidemiological transition theory can help shed light on the different variants of mortality transition, there is still much to be understood about mortality differentials and the factors influencing them, particularly for a population like Lao PDR which is at the earliest stages of development. As far as mortality and its determinants are concerned, knowledge in the area of mortality transition still lags behind that of fertility (McDonald, 1982).

1. 3. Literature review on mortality studies in Lao PDR

Although mortality in Laos is at a very high level by world standards (SSC, 1986; World Bank, 1995b), to date no comprehensive study of mortality in the country has been carried out for Laos. Prior to the foundation of Lao People's Democratic Republic, a number of health surveys may have been carried out, but no report or record of any could be found in the country. This may be due to effects of the campaign,

launched by the new socialist regime immediately after the liberation of the country, for the eradication of the traits of the former regime. This may have led to the loss or destruction of documents produced during the old regime, and also to a general lack of interest in any kind of research within government and academic circles. One example of such a survey was a health survey for the Mekong valley which was carried out in order to determine the disease patterns, sanitary and hygienic conditions, health related attitudes, fertility and mortality, and environment conducive to epidemiological trends in Laos. However, the survey covered only a very limited area (fifteen villages along the Mekong basin): the universe from which the sample was drawn consisted of the approximately one-third of the country, which was under Royal or rightist government control (Breakey and Voulgaropoulos, 1976).

The first vital statistics survey after the establishment of the new regime was conducted in 1986, with a main purpose of providing estimates of fertility and mortality for the purpose of deriving the rate of natural increase needed for a population projection for the country. Except for providing crude death rate and total fertility rate, no other analysis has been done on mortality differentials and patterns prevailing in the country, let alone on the cultural, social and economic correlates (SSC, 1986). It was not until 1993-94 that the first comprehensive fertility and mortality survey was incorporated into a living- standard-type of survey called the Lao Expenditure and Consumption Survey and the Lao Social Indicator Survey (LECS and LSIS). However the published results of these two surveys only gave the national estimates of infant and child mortality and maternal mortality (NSC, 1995b).

There have been a number of reports and surveys conducted by other agencies about the nutritional and health situation in Lao PDR but they are mainly of epidemiological nature . The various nutritional surveys conducted in the country with

the courtesies of the World Health Organization, Ministry of Health and various non-government organizations were not nationally representative and far from providing information on mortality differences and the underlying factors of mortality outcomes (for example, Kripps, 1984; Douangmala and Philavong, 1990; Ministry of Health, 1990; UNICEF, 1987, 1989; Enfants et Developpement, 1990; cited in UNICEF,1992).

The most recent mortality analysis reported by the Institute for Maternal and Child Health Care(1994), using data from the Lao Social Indicator Survey (LSIS) mostly focuses on fertility and its determinants, and estimates of fertility and mortality rates, including maternal mortality by the sisterhood method. However, these estimates are those officially agreed upon by the National Statistical Centre (NSC) and necessarily the same figures as those published by the NSC. The Institute's report also looks at seasonal variations in births and infant mortality. It is found that the majority of births and infant deaths occur during dry season, around March to April, and peri-natal deaths constitutes the majority of infant death. It also examine infant mortality differentials by mother's education, rural or urban residence and ethnicity (MCHI, 1994).

Recently a survey was carried out to give policy makers a comprehensive understanding of the state of fertility and some of its socio-economic determinants, birth spacing, attitudes of the population towards family planning, and maternal and child mortality prevailing in the country (NSC/LWU, 1995).Through this survey a limited number of fertility and mortality estimates were produced. In addition to estimates of infant and child mortality, this survey also provides a brief report on infant mortality differentials by maternal age, place of residence, occupation and education. However, there is no information or discussion on the general mortality level and pattern in the report of this survey (NSC/LWU, 1995).

Another attempt to derive mortality estimates was made in a 1993 study

(Fauveau, 1995), which sought to determine the causes of maternal deaths and their determinants among Lao women. This study, however, is far from providing any satisfactory maternal mortality rate for the country due to its small number of cases. In general it can be said that mortality and its determinants in Lao PDR and their variations across regions and population subgroups still remain unexplored.

1.4. Research problems and importance of the research

1.4.1. Research problems

1.4.1.1. Persistent high mortality

A major demographic feature of the population of Laos is the persistence of relative high mortality by world standards. The mortality level in Laos has declined only modestly: from an annual crude death rate (CDR) of 23 deaths per 1000 population in the 1960s and early 1970s to just over 20 during the period 1975-80 (ESCAP, 1983). The reported CDR was 17 per 1000 population in 1985 and 16 per 1000 population in the period 1987-90 (SSC, 1990).

Life expectancy at birth of the Lao people is low. The Economic and Social Commission for Asia and the Pacific (ESCAP)(1983) estimates suggest that life expectancy for both sexes increased from 40.4 years in the 1960s and early 1970s to 43.5 years during 1975-80. However, the accuracy of these estimates is in question since they are not accompanied by any sound analysis as to the validity and reliability of the data on which they are based.

Estimates of mortality for Laos obtained from various sources differ greatly. ESCAP's estimates of infant mortality rate for Lao PDR were 180, 150 and 135 per thousand live births for the 1960s, 1970s and the 1975-1980 period, respectively (ESCAP, 1983). Later statistics gave an infant mortality rate in 1985 of 117 per thousand live births (SSC, 1986). The most recent estimates for the year 1992 by the

Maternal and Child Health Institute of the Ministry of Health revealed that infant mortality rate stood at 125 per thousand live births and maternal mortality rate was 656 per 100,000 live births (MCHI, 1994: 47).

Given the background of a subsistence agrarian society with as yet limited progress in development and poor health conditions, two important questions need to be answered, based on sound analysis. What are the levels and patterns of mortality in Laos? Are there any mortality differentials between different ethnic groups, regions and urban or rural residence and from where do they arise?

1.4.1.2. Health problems

The most important obstacles to better health in Lao PDR are believed to include malnutrition and under-nutrition, environmental contamination, style of living, ethnic-specific health beliefs and behaviours, high fertility, inadequacy and poor quality of and access to health services, and lack of preventive health programs.

With respect to health and morbidity, the most prevalent diseases in Laos are infectious, parasitic and respiratory diseases such as malaria, diarrhoea, dysentery, leprosy, tuberculosis and respiratory infections (ESCAP, 1983 ; Ruzicka and Kane, 1986). Throughout the last two or three decades malaria has remained the major killer in the country (UNICEF, 1992). There exists a severe nutritional problem among Lao people (MCHI, 1994: 48; World Bank, 1995b).

Environmental contamination is another factor leading to high mortality. Housing conditions including toilet, water supply facilities, type of kitchen and lighting can presumably affect health largely through their impact on sanitation, thus affecting the incidence of infectious diseases (Kent, 1991: 33). Housing conditions in Laos differ among rural and urban populations and different ethnic groups. These conditions in turn could relate to different degrees of sanitation. The prevalence of latrines is believed to

differ greatly between urban and rural areas and between various socio-economic groups of the population.

The problems of illiteracy, poor health and poverty in Lao PDR affect the ethnic minorities more seriously (Batson, 1991: 142). Different localities and regions, to some extent provinces, within the country have different levels of economic and social development and are inhabited by people with different ethnic background, culture, religion and beliefs, and practices. In many parts of the world, significant differences have been observed in child mortality rates among different ethnic or religious groups, and such differences are generally accounted for in terms of substantial differences in other variables such as education or economic status (Kent, 1991). Ruzicka and Kane (1986) suggest that it may be that in the developing countries the environment and living conditions differ widely between different regions within the country in many respects: for instance, in the structure of endemic diseases and disease incidence and prevalence, in provisions for adequate medical care and access to such services not only in terms of distance but also in economic and social terms.

In addition to housing materials, other factors such as access to clean and safe water, electricity, toilet facilities, household outlays on food and health, personal health beliefs and health control, food habits and taboos to some degree are suspected to have influences on mortality and to produce mortality differentials across the various regions and subgroups of population in Lao PDR. However, little is known about health beliefs, practices and health seeking behaviour of the various Lao ethnic groups.

Another factor that could produce a negative effect on health, particularly on mother's and child's health, is high fertility. High parity and close birth intervals are common among Lao women. Northrup (1986) stated that an unreported major factor in mortality is high fertility, as seen in most developing countries. Fertility in Laos is

particularly high, the highest in South East Asia. The total fertility rate in 1985 was estimated at 6.8 children per woman (SSC, 1986: 5). High mortality may sometimes be a response to high fertility instead of a stimulus to it (Scrimshaw, 1978).

Experience in the Third World countries shows that many diseases are preventable or controllable at fairly low cost. In the case of Laos, preventive health programs are theoretically in place, but they are haphazardly conceived and poorly implemented (ShuiMeng, 1991). Primary health care is unfortunately in its infancy stage. Preventive and curative intervention measures may be of limited efficacy in societies with a high prevalence of malnutrition of children, poor sanitation and inadequate education and health care (Ruzicka and Hansluwka, 1982).

The estimated proportion of children aged 12-13 months in the whole country immunized by the extended program for immunization (EPI) against all six childhood diseases was only 2 to 3 per cent in 1985 (ShuiMeng, 1991: 163). The poor immunization coverage, is, however, compounded by poor communications and transportation infrastructure, the lack of medicines and facilities (refrigerators to keep vaccines, electricity to run the refrigerators, no access to rural areas and so on).

Access to safe drinking water is another health issue in Lao PDR (UNICEF, 1992). This situation is even worse for rural people. The majority of the rural population must fetch water from rivers, streams or even ponds (UNICEF, 1992:112).

The problems in the Lao public health system was confounded a World Bank model of structural adjustment adopted by the government in the mid-1980s, which entailed several cuts in public health expenditures. The groups of the population who would suffer from this structural adjustment strategy will certainly be the low-income and underprivileged groups. Given that the majority of the population remains poor, and in the light of the changing economic atmosphere (cost of living rising and health

services becoming more expensive for the majority of people) and new development strategies adopted by the government, the effects of the health services strategy on the health of the population and survival of infants and children need to be investigated. It is possible that the mortality situation will get worse. However, Hill and Pebley (1989) have suggested that it is difficult to evaluate whether structural adjustment policies have altered or will alter a family's economic status sufficiently to affect mortality rates.

1.4. 2. Importance of the research

Lessons from the Third World settings covered by the studies mentioned earlier indicate that so far mortality decline has occurred in the countries where development has, to some extent, taken place and reached a large proportion of the population. In most developing countries, particularly in Asia, there is a certain degree of development in the areas of health and sanitation facilities, public utilities, education, road and transportation infrastructures, which in turn makes possible the expansion of health care and sanitation services, distribution of food and other life necessities, and the spread of education to reach even the rural and remote population. Knodel et al. (1987: 32), in their study of fertility decline in Thailand, found that both fertility and mortality are declining in a setting where educational and health care facilities are improving in the countryside and where a wide variety of consumer commodities is increasingly available to villagers coupled with the easier access to urban areas for villagers.

There are many mortality studies of low-income countries, but they are not necessarily relevant to a particular socio-economic context. The mortality situation in a country where development is at its embryonic stage and limited to only a small proportion of the population might be different in many ways from those found in other low income countries. Variations of mortality and their determinants between different population subgroups are totally unresearched.

This thesis constitutes the first mortality research for Laos using reliable and nationally representative datasets. For demography, it seeks to provide new knowledge of the mortality situation of a multi-ethnic, subsistence agrarian society in almost a predevelopment context - a setting, moreover, which is quite different from other least developed and low-income countries. Not only does this research provide an insight into the mortality conditions of a population little known to the outside world, it is hoped it will also provide health authorities, policy makers and program designers with a more precise knowledge of the mortality levels and differentials they are facing, and better understanding of the inter-related factors underlying the mortality conditions in Laos.

It is also worth noting that, the social development objectives with respect to mortality, set out by the Ministry of Health and the Committee for Planning and Cooperation (Douangdy, 1995: 86-90) of the government of Lao PDR from now to the year 2000 are as follows :

i) To reduce the infant mortality rate from 125 to 50 per 1000 live births.

ii) To bring down the under-five mortality rate from 182 to 70 per 1000 live births.

iii) To reduce the maternal mortality rate from 656 to 300 per 100,000 live births.

iv) To bring down measles deaths and measles cases by 90 per cent.

v) To lower deaths due to diarrhoea among children aged below five years old by 50 per cent and to reduce diarrhoea incidence rate by 25 per cent.

This research will contribute to attaining these objectives if it can provide a sound basis for understanding the mortality patterns and differentials across regions, ecological zone and other population subgroups. Hence, a broad aim of the thesis, beyond presenting new information on mortality in Lao PDR, is to contribute to the improvement of the health and longevity of the Lao population.

1.5. Background and context of the research

Before examining mortality differentials in any country, it is helpful to have some knowledge of its geographical location, land and people, climate, society and political development. All these characteristics potentially have some influence on the observed levels and differentials in mortality.

1.5.1. Land

1.5.1.1 Geography

Being located in the center of the South East Asia peninsula, Lao PDR is a landlocked country. Lao PDR shares common borders with China (505 Kilometers) and Myanmar in the north, with Vietnam (2069 Kilometers) in the east, with Thailand (1835 Kilometers) in the west and with Cambodia (435 Kilometers) in the south. The northern-most point of the country lies at north latitude 220 30'; the southern-most point is at north latitude 130 04'. The eastern- and western-most points are located at longitudes of 1070 38' and 1000 05' respectively (NSC, 1995a).

Lao PDR occupies a narrow but long-stretched area of 236,800 square kilometers. The length of the country from north to south is about 1000 kilometers. The width of the country in the north, at latitude 20^0, is about 500 kilometers, while that in the south, at latitude of 16^0, is approximately 200 kilometers (Sisaliao et al. 1989: 5). Figure 1.1. gives a map of the location in the Southeast Asian region and provinces of Lao PDR .

Geographically, Lao PDR can be divided into three ecological zones, namely lowland plain, high plateau and mountainous areas. In fact, the majority of the country is terrain, almost 80 per cent of the total area of the country, is covered by razor-edged, steep and forested high mountains and plateaus. The northern, north western, eastern

Figure 1. 1. Administrative map of Lao PDR

and south eastern parts of the country are mainly mountainous. The highest peak (2000 meters), Phu Bia, is located in the northeastern province of Xiengkhuang. In the central and southern part of the country, the terrain is mountainous in the east along the Annamite chain which forms the natural eastern border with Vietnam. Westwards, the elevations gradually diminish through various plateaus until becoming extensive plain areas extending beyond Lao PDR 's border the (Mekong river) into the plain of northeastern Thailand.

The lowland plain mainly lies along the basin of the Mekong river stretching from Vientiane province to the Lao-Cambodia border (Sisaliao et al., 1989: 89). The Mekong river, originating in the Himalayas in Tibet, is the main artery of the country. It flows through Lao P DR for a distance of 1865 kilometers or 44 per cent of its total length (Sisaliao et al., 1989 : 89). Lao PDR possesses a large potential for hydro-electric power generation and rich natural resources such as forests and mineral resources, the majority of which remain unexplored.

1.5.1.2. Climate

Climate conditions in Lao PDR exert a major influence on the types and outcomes of the production and livelihood of the Lao population. Lao PDR lies in the tropical warm and humid zone of South East Asia. Its climatic conditions are influenced by the monsoon in both seasons. Because of its particular location and topography, Lao PDR experiences quite different weather from that occurring in its neighbouring countries. Differences in climatic conditions between different regions within Lao PDR are also observed. The temperature patterns vary according to elevation.

There are two distinctive seasons in Lao PDR, rainy and dry. The rainy season is longer than the dry season, normally lasting from mid-April to September with the exception of the plateau areas where it starts as early as March. Since agricultural

production in Lao PDR is predominantly a subsistence and rainfed system, and more than 80 per cent of the Lao population live in the agricultural sector, the rainy season is considered the production season. During it, protein sources from fishing are also relatively abundant. The dry season lasts from October to April. The average yearly humidity varies from 51% in the centre to 96% in the north of the country (NSC, 1995:14). The average yearly rainfall varies between different parts of the country and differs from year to year. With the increased rate of rain forest destruction, during the last twenty years rainfall has shown more irregularity (NSC, 1995).

1.5.2. Population and society

Until 1985 when the first complete national population census was held, little was known about the population profile of Lao PDR. A number of censuses had been taken during the colonial period and the Indochina war, but they covered only parts of the country (NSC, 1995:4). Prior to the establishment of Lao PDR, the only known estimate of population size, claimed to come from a census specifically carried out for the whole country in 1959-61, was 1.9 million persons (NSC, 1995: 4).

The population of Lao PDR, as of March 1, 1985, was estimated to be 3.58 million persons, of which 49 per cent were male and 51 per cent are female. This gives a sex ratio for the whole country of 96 males per 100 females (SSC, 1992: 4). The Lao population as of March 1, 1995 was 4.58 million persons, and the sex ratio for this year had increased to 97.8 males per 100 females. Based on the intercensal increase, the average annual growth rate of the Lao population is 2.4 per cent (NSC, 1995: 10).

In 1985, the population density of Lao PDR was 15 persons per square kilometer. This figure had risen to 19 persons per square kilometer by 1995. Geographically, there is a very sharp contrast in population density between various provinces of the country, ranging from 7 persons per square kilometer in some northern

and southern provinces of the country to 96 persons per square kilometer in Vientiane Municipality, the capital city of the country (NSC, 1995: 18).

In 1985, the population in the age groups from 0 to 14 years old made up about 44 per cent of the total population, while persons in the age groups 15 to 64 years old and persons aged 65 and above accounted for 52 per cent and 4 per cent respectively. This age structure, together with the results of the 1986 Fertility and Mortality Survey which gave a crude birth rate of about 42 per thousand population and a crude death rate of 17 per thousand, describes a population which has persistently experienced a regime of high fertility and high mortality, and a population still in the early stage of the demographic transition (SSC, 1992: 15, 20).

The Lao population is officially classified into three major ethnic groups, namely Lao Loum (Lowland Lao), Lao Theung (Upland Lao) and Lao Soung (Highland Lao). The classification is mainly based on the older concepts of ethno-geomorphics rather than of modern ethno-linguistics (Chazee, 1994: 10). However, this classification is widely accepted, since it coincides with differences in the geographic locations inhabited by these three groups and with differences in the methods of livelihood adopted by them. If the classification is made according to ethno-linguistic concepts, Lao Loum belong to the family of Lao-Tai language groups, Lao Theung are under Mon-Kmer language groups, while Lao Soung are classified under Miao-Yao and Tibeto-Burman family (NSC, 1992: 13) (Chazee, 1994: 13-14).

Each of these major ethnic groups have their own language, dialects, culture, customs and traditions which vary greatly one from the other. However, Lao, the language of the Lao Loum family, is the official language of the country and, with the exception of the older people in a number of tribes, is understood by all ethnic groups. There are several different dialects even among the Lao Theung and Lao Soung, such as

the four major dialects spoken by Lao Soung including Hmong (UNICEF, 1992).

As indicated by their name, the Lao Loum, whose main livelihood is rainfed rice cultivation, prefer to live in the plain, in valleys surrounding rivers and their tributaries, usually at altitudes not above 400 meters above the sea level. Lao Theung live at altitudes between 500 meters and 1000 meters on hilly terrain and plateaus. Lao Soung live on the mountain tops or in terrain higher than that inhabited by Lao Theung, usually between 800 meters and 1600 meters. Both the Lao Theung and Lao Soung practice slash and burn cultivation. Rice, mainly sticky (glutinous) rice, is the main staple food of the Lao people of all ethnic groups, with the exception some minority groups of Chinese or Vietnamese origin.

1.6. Brief history

The Lao PDR was founded in 1975 following the victory of the Pathet Lao Army (the socialist regime) over the rightist government of the Kingdom of Laos after a protracted war which had lasted for more than 30 years. According to the history written by Maha Sila Vilavong (1958, 1964), the present country is only part of a much larger kingdom of Lane Xang, which means a million elephants, established by King Fa Ngum in A.D. 1357. The territory to the West of Lane Xang Kingdom extended beyond the right bank of the Mekong river to cover almost all Korat plateau of the present Thailand. The Kingdom of Lane Xang enjoyed prosperity from the mid 14th century until the end of the 17th century (Sisaliao et al., 1989 : 167). After the death of King Fa Ngum in 1373 A.D. about 20 kings reigned over the Lane Xang Kingdom before it was eventually divided into three separate kingdoms (Vilavong, 1958, 1964).

King Samsenetai, son of King Fa Ngum, ruled the Lane Xang Kingdom until the early 15th century. It was this king who carried out the first ever population head count – from which his name, Phra Chao Samsene Tai, originated (Phra Chao Samsene Tai

means King of 300,000 Tai). Several kings ruled after him until the mid 16th century when King Sayasetha moved the capital of Lane Xang Kingdom from Xiengthong (the present Luangphrabang) to Vientiane, the present capital of Lao PDR, following several invasions by the Burmese (Vilavong, 1964; Sisaliao et al., 1989 : 229).

The civilization of Lane Xang Kingdom reached its peak during the reign of King Suriya Vongsa (A.D. 1637-1694) when Gerrit Van Wusthof, a Danish envoy and the first European, paid a visit to the Kingdom. Vientiane became a centre for Buddhist education where monks from neighbouring countries came to study. Following the death of King Souriya Vongsa in the early 18th century, Lane Xang Kingdom split into three autonomous kingdoms: Luangphrabang, Vientiane and Champassack. These kingdoms engaged in war with each other on a constant basis, and each sought alliance with its more powerful neighbouring countries. By taking this opportunity, the Siamese invaded Vientiane in A.D. 1778. In the early 19th century, King Anu organized a series of revolts against the Siamese in order to free Laos from Siamese suzerainty. He was defeated in 1827 by the Siamese who destroyed the whole of Vientiane town and deported most of the population of the Vientiane Kingdom to Siam. All the three kingdoms were then colonized by Siam until the end of the 19th century when the French begun their occupation of Indochina in 1886. Laos was incorporated as French protectorate in 1893 when France and Siam signed a treaty that ceded all Lao territory on the western bank of the Mekong river to Siam. It was only in 1902 and 1904 respectively that the two Lao provinces, Champassack and Xayaburi provinces, on the left bank of the Mekong river were added to the present territory of Laos.

Under French rule, little development took place. The French imposed heavy taxes on the people. The colonial administration issued currency notes and collected from the people silver and gold bars and coins which were transported to France. The

majority of Lao people lived in poverty with poor health and extremely limited access to education. Education was in the French language and only open to the elite class of people who later would find employment in the colonial administration. Until 1939, there were few primary schools and only one lower secondary school in the entire country. A small number of students, mostly the off-spring of royal families, high officials or officers of the colonial authority, had to travel to Tonkin or Cochinchina or France for high secondary or vocational education (Sisaliao et al., 1989: 175). In terms of health care, in 1938, there were only one hospital and six dispensaries, eight mobile medical trucks, 27 pharmaceutical outlets and three mobile therapeutic units in the country. The high prevalence of diseases and epidemics were likely to have inhibited the growth of the Lao population (Sisaliao et al., 1989:176).

Although in the late 19th century and early 20th century, there were a number of unorganized anti-French resistance movements carried out by the Lao Theung and Hmong, it was in the early 1940s that the organized anti-French movement of the Lao people to win independence for the country really gained strength under the leadership of the so-called " Noe Lao Issara" (United Front of Free Laos) headed by Prince Phetsarath and Prince Souphanouvong (the " Red Prince") . In 1945 the country, for the first time, proclaimed independence from France. However, after the defeat of the Japanese army, the French, with the help of a southern prince, Boun Oum, suppressed the patriotic movement and re-established the administrative control over Laos. This forced the Lao movement to seek refuge in Thailand where it formed an a government in exile.

It was only in 1954, after the defeat of the French army in Dien Bien Phu that Laos truly became an independent country. However, during the period 1954-1975 Laos was ravaged by civil war or the so-called secret war between the royal government army

backed by the United States and the Patriotic Front army backed by Vietnam, China and the USSR. After 1964, the eastern part of Laos played an important part in the Indochina war, since most of the famous Ho Chi Minh trail lay along the liberated zone of Laos.

During this time Laos was heavily bombed by US planes. It is claimed that the tonnage of bombs dropped in Lao territory was higher than that dropped in Europe during the whole of World War II. Hundreds of thousands of people became displaced persons (Sisaliao et al., 1989). During this time, mortality in both the zones was very high. In Laos alone, about 100,000 persons became casualties of the Indochina war (UNICEF: 1992: 5).

The rightist government heavily depended on assistance from the United States, which averaged around 350 million dollars per year. Of this, only 50 million dollars were economic aid; the rest for military aid (Sisaliao et al., 1989: 181). In spite of this, the Patriotic Front gradually gained territory from the rightist government until 1975 when it finally achieved victory. The Patriotic Front's zone increased in size, from 50 per cent of the area and one-third of the population in 1954 to about four-fifths of the area and more than half of the population in 1973 when a truce was reached between the two armies (Sisaliao et al., 1989:183).

In 1975, the royalist government was overthrown and on the 2nd of December 1975 an extraordinary session of the national assembly was held and the foundation of the Lao People's Democratic Republic was proclaimed. From that time onwards, Lao PDR has been under single-party rule by the Lao People's Revolutionary Party (LPRP), and governed by a socialist government. As noted earlier, thousands of people have fled the country to escape communist rule. The Party ruled by decree rather than by law and it sought to control all political and economic aspects of the country. It was only in 1991 that the first national constitution was proclaimed and several laws came into force.

In the government administrative structure, all important positions such as ministers, provincial and district governors, chiefs of police and defense department officials are filled by members of the LPRP. All members of the Politburo of the LPRP are also members of the government cabinet, while almost all provincial governors are members of the LPRP Central Committee, which is next to the Politburo in the party hierarchical line.

Although the Lao PDR is a socialist country, it is socialist only in political sense and it is a Lao type of socialism that tries to mould together the national identity, traditional values and culture, and Marxist-Leninist ideas. Except for the wealth belonging to the bureaucrats of the royalist government who fled the country, no private land or property has ever been confiscated by the State, unlike what happened in China and Vietnam. (A brief effort at collectivization was soon abandoned – see below.)

1.7. The socio-economic development of Lao PDR

The very low level of socio-economic development is one of the important features of the context under which study of mortality in thesis is carried out. The structure of the Lao economy is heavily agrarian. The agricultural sector makes up about three-fifths of the total production of the country and employs more than 90 per cent of the labour force (SSC, 1991). Lao PDR is abundantly endowed with forests (it is the largest remaining forest area in South East Asia), mineral deposits such as tin, aluminum, iron, gold, precious stones, gypsum, potassium and many other minerals, and hydro-power potential. Much of these resources have not so far been exploited for commercial purposes.

Partly because road and transportation infrastructure is poorly developed, the Lao economy is little monetized; except for some cash crops like coffee, cardamom, tea, cotton, corn and sesame, the majority of agricultural production is for self-consumption

or bartered within or with neighbouring villages. Immediately after the take over of the country, the present regime has been putting a major effort into the development of agricultural production, through heavy investment in large scale irrigation and the establishment of the state-owned farms. Manufacturing, construction and services constitute only a small proportion in the gross national product of the country.

In its urgent drive to achieve food self-sufficiency in its early years of rule, in1977 the government attempted to organize peasant production on a collective basis through the formation of agricultural cooperatives, state farms, collective working units, etc. This move was only realized in a few parts of the country. Farmers were asked to consolidate their land and other productive assets and labour. The subsequent production was divided, after payment of the agricultural tax, among members of the cooperatives according to the work points accumulated by each member. Such efforts at collectivization turned out to be a failure. Instead of achieving self-sufficiency in food production, many localities suffered food deficits, partly due to unfavourable weather during these years, but mainly due to the lack of experience, inefficient management and absence of incentives in collective production. By the early 1980s, almost all agricultural cooperatives and state farms had been dissolved, and production was carried out privately.

Following the economic liberalization taking place in the Soviet Union, in 1986 the Lao PDR embarked on its own version of Perestroika, called the New Economic Mechanism (NEM). Though the NEM was essentially introduced to free the state from its budget burden and reduce the budget deficit which had plagued the Lao economy since the inception of Lao PDR, it nevertheless opened the Lao economy to the world, putting it on the path towards a market economy. Until 1987, except for trade in petty goods carried out by households and the informal sector, trade in important goods such

as rice, salt, meat, and other life necessities was controlled and carried out only by State-run organizations.

During the course of the implementation of the NEM, trade, prices and exchange rates, which had been controlled by the State, were liberalized, and the role of the private sector has been promoted. Table 1.1 below provides a brief summary of the economic performance of the country in the early 1990s.

Table 1.1: Percentage share of major industry groups in gross domestic product (GDP), annual GDP growth rate, and real GNP per capita, Lao PDR, 1990-94.

Industry	1990	1991	1992	1993	1994
Agriculture	60.7	57.3	58.0	56.3	56.4
Manufacturing	14.4	16.6	16.7	17.4	17.8
Services	24.1	24.6	23.9	24.3	23.7
Import duty	0.9	1.4	1.4	2.0	2.1
GDP annual growth rate (%)	6.7	4.0	7.0	5.9	8.1
Real GNP per capita ($)	200	220	250	290	n/a

Source: Adapted from Table 92, p.130 and Table 114, p. 169 of the 1975-1995 Basic Statistics about the Socio-economic Development in the Lao PDR, NSC, 1995a.

With respect to economic performance, it can be seen that the economy of Lao PDR has been improving over time. The estimate of real GNP per capita for Lao PDR in 1988 was US$ 180 (UNICEF, 1992) and this figure rose to US$ 200 in 1990 and US$ 290 in 1993. Table 1.1 also shows the decrease in the share of the agricultural sector in GDP, probably due to the gradual decrease in the export of logs which used to form a major component of agricultural sector production, and the slowly increasing importance of the manufacturing sector.

Due to the lack of an official national accounts system prior to 1990, differences between the performance of the centrally planned economy prior to 1987 and the current market-oriented economy cannot be precisely ascertained. Nevertheless, the economic

reform has brought about macro-economic stability: the inflation rate has decreased from a two-digit level prior to 1990 to a single-digit figure in the 1990s (NSC, 1995a). Since 1987, the official exchange rate and the parallel free-market rate have converged and remain quite stable over time. There has been an appreciation of the real exchange rate and declining relative prices for agricultural products, particularly food (World Bank, 1995a and 1995b). However, during the late 1980s and early 1990s, it seems likely that the effects of the economic reform and improvement in the economy of the country have not been felt by the majority of the population, particularly those in the rural and remote areas. The principal gainers have been a handful of people in the non-agricultural sectors and the elite in the major urban areas.

Overall it can be said that social development, except perhaps in the area of education, still lags behind economic development. As mentioned above, infant and maternal mortality rates are very high, health services (mainly curative) are concentrated in major urban areas only. Access to transportation and other social services is quite limited.

1.8. Thesis objectives

With the above background in view, the objectives of this research are as follows:

1. To evaluate and assess the mortality data available in the Lao PDR for the estimation of adult, infant and child mortality.
2. To estimate the levels and patterns of adult mortality.
3. To investigate and explain differentials in adult mortality between different regions, agro-ecological zones, urban-rural residence and ethnic groups. Because of the limitations of the available data and the design of the survey used, the analysis of mortality differentials at the provincial levels is not feasible.
4. To estimate levels of infant and child mortality by sex and to examine trends in

infant and child mortality.

5. To construct life tables by sex at the national level.
6. To present differentials in infant and child mortality and investigate their determinants.
7. To explore the economic, social, cultural and behavioural context and the factors influencing mortality in Lao PDR, especially infant and child mortality.
8. To provide general policy guidelines for the improvement of the mortality and health situation in Lao PDR.

1.9. Thesis organization

The thesis starts with this chapter by providing an introduction and theoretical background to the study, and a statement of the research problem and objectives. Chapter 2 presents the estimation of adult mortality, including a discussion of the data set and its limitations and evaluation, as well as the methodology used. Chapter 3 presents estimates of infant and child mortality levels and trends, again including a discussion of the data set used, its limitations and evaluation. The results obtained in Chapters 2 and 3 are combined to produce national life tables in Chapter 4. Chapter 5 presents differentials in adult mortality for major sub-groups of the population, while Chapter 6 presents differentials in infant and child mortality by various demographic and socio-economic variables. The analysis of infant and child mortality is extended in Chapter 7 through a multivariate analysis of its determinants. Finally, Chapter 8 summarises the findings and suggests how they mesh with qualitative features of the Lao economy, society and environment. The thesis ends with a consideration of policy guidelines for Lao PDR in the area of mortality.

Chapter 2
Adult mortality

2.1. Introduction

Adult mortality is a relatively neglected health issue in developing countries. In most parts of the less developed world, old-age mortality, the main causes of death in early adulthood and middle age, and the age-distribution of adult deaths at the subnational level are almost completely unknown (Timaeus, 1991: 552). In the absence of a complete civil registration system and other potential sources of data in the Lao PDR, adult age-specific mortality rates and life expectancy in the country have so far remained unknown.

The 1985 Population Census did not ask questions on fertility or mortality. Before the conduct of the 1986 Fertility and Mortality Survey (FMS) and the Multi-round Vital Statistics Survey (MVSS), information on vital events was normally obtained from population control books for villages within municipalities of the capital cities of the major provinces. Such information is mostly far from complete in coverage and accuracy. The books are not updated as required, since their main purpose is the control of population movement, production levies and security, rather than civil registration *per se*.

A sample survey of fertility and mortality, the 1986 Fertility and Mortality Survey (FMS), covering only 60 villages was carried out in 1986 with the objective of obtaining the crude death rate and crude birth rate and hence the natural rate of growth, for the purpose of carrying out the first official population projection for Lao PDR. The reported crude birth rate and crude death rate were 46 and 17 per thousand population respectively, which gave a natural rate of increase of 2.9 per cent (SSC, 1992).

Because of its small sample size and the large sampling errors involved, only the number and proportions of deaths by five-year age group have been published from the 1986 FMS. Though the 1986 FMS was not specifically designed to provide estimates of age-specific mortality rates, an estimate of the infant mortality rate of 118 deaths per thousand live births and an estimate of life expectancy at birth of 50 years were also included in its report (SSC, 1992: 28). These estimates were subject to large sampling errors and therefore referred to only as provisional, and until 1992 they were not made available to the general public and were used only in some official documents.

In 1995, infant and child mortality rates estimated by direct and indirect methods, using data obtained from the 1992-93 Lao Social Indicator Survey, were published (NSC, 1995b). In the same year, other estimates of infant and child mortality covering the 15-year birth cohort before May 1994, using data of the 1994 Fertility Birth Spacing Survey, also became available (NSC/LWU, 1995).

The Multi-round Vital Statistics Survey (MVSS) was conducted in 1988. With its large and national representative sample, covering 300 villages on a nationwide basis, the MVSS was intended to provide reliable estimates of fertility and mortality as a basis for the derivation of a more realistic growth rate of the population and for the establishment of a sustainable civil registration system in the future. These data, which have not been previously analysed, are used in this analysis. Since the degree of under-reporting of infant and child deaths is quite high (D'Souza, 1993), these data are used in this analysis to derive adult mortality, defined as mortality at ages 5 and over.

The first purpose of the thesis is to derive estimates of the age-sex patterns of adult mortality at the national level. The estimation of differentials in adult mortality by various characteristics of the population is presented in Chapter 5. The present chapter first examines the data set used to determine adult mortality. It starts with a description of the data set, including sample design, method of enumeration and data limitations,

and an evaluation of the quality of the data and adjustments made to the data. The age-sex pattern of adult mortality for the whole country is then presented.

2. 2. Data set

The data set used for the analysis of adult mortality is the Multi-round Vital Statistics Survey (MVSS). This survey was conducted to meet the need for comprehensive information on fertility, mortality, and migration in order to prepare population projections to be used in long term socio-economic planning for the country. This survey was a part of a larger project attempting to institute a civil registration system. The vital statistics survey was to be conducted in 300 villages concurrently with the establishment of a civil registration system and training of registrars in another 500 villages. The civil registration part of the project has however never achieved the expected results.

2.2.1. Sample design

The undertaking of the MVSS was the responsibility of the National Statistical Centre (NSC), the central statistics office of the government of Lao PDR which before 1992 was known as the State Statistical Centre (SSC). The sample was designed to be nationally representative. A sample of 300 villages out of the total 11,512 villages in the country was selected. For each province the number of sampled villages was obtained by multiplying 300 by the ratio of the province population to the total population of the country. Villages were selected using systematic sampling procedures, without any stratification, with a random start from a list of villages obtained from the 1985 national population census. Table 2.1. gives the number of the villages and population in the whole province and the number of selected villages and their population as enumerated in the 1985 population census.

Table 2.1. Number of sampled villages and their population in relation to total population and villages by province, at 1 March 1985.

Province	Number of villages		Population	
	Province	Sample	Province	Sample
Vientiane Municipality	411	31	377,409	18,600
Phongsaly	600	10	122,984	2,683
Luangnamtha	452	8	97,028	2,841
Oudomxay	1,115	21	250,936	5,960
Bokeo	272	5	54,925	1,569
Luangphrabang	1,205	25	295,475	11,912
Huaphanh	839	18	209,921	4,950
Xayaburi	408	14	159,790	7,443
Xiengkhuang	611	14	161,589	5,176
Vientiane	803	22	264,277	9,004
Bolikhamsay	520	10	122,300	5,193
Khammuane	824	18	213,462	6,371
Savannakhet	1,522	45	543,611	19,077
Saravane	615	16	187,515	7,210
Sekong	323	4	50,909	1,715
Champasack	838	33	403,041	14,684
Attapeu	154	6	69,631	2,199
Total	11,512	300	3,584,803	126,587

Source: Report on Multi-round Survey of the Lao PDR, 1988-1991, Table 1, p. 7, prepared by Stan D'Souza, Vientiane, 1993.

All households in the selected villages were interviewed, except in the capital city of the country, Vientiane Municipality, where only 100 households per village were selected for interview. Each village in Vientiane Municipality was divided into clusters of 100 households and a cluster was selected randomly. The reason for this practice was that villages in Vientiane Municipality are larger on average than other villages. Through the selection of only 100 households, the sampled population in each village in Vientiane Municipality would approximately equal 600 persons, the average population size of the selected villages for the rest of the country.

Moreover, since the MVSS Baseline survey conducted in July 1988 provided an estimate of the population of the 300 selected villages, data for each province were weighted according to the population recorded (at 1 July 1988) in the MVSS in relation

to the total population of the province estimated for mid-year 1988. The mid-year total population of each province was estimated by the State Statistical Centre in 1986 by projecting the 1985 census population according to an estimated annual growth rate of 2.9 per cent, obtained from the 1986 FMS (SSC, 1986). This improved the representativeness of the survey results.

2.2.2. Method of enumeration

The MVSS is a series of surveys conducted every six months. The field work was conducted from July 1988 to July 1991 covering altogether a baseline survey and six rounds of follow-up surveys referring to 1 January and 1 July of respective years. Field work was conducted by one enumerator in each village and two or three supervisors per province. Normally the enumerators were statisticians from the provincial statistical office and the supervisors were either the chiefs of the statistics divisions of provinces or statisticians from the State Statistical Centre. Enumerators and supervisors were trained before to the baseline survey. A pilot survey was also conducted at this time. Further training was given to both supervisors and enumerators every two rounds of the survey.

A questionnaire was administered to each household. The information collected in the baseline survey included household member's name, age, sex, relationship to the head of household, marital status and ethnic group affiliation. The unit of enumeration was the usual resident of the household. Only private households were included in the survey. Collective households such as military barracks, police and student dormitories, public and enterprise collective households, hotels, hospitals and so on were all excluded from the survey.

A time reference of six months was used as a cut-off in defining usual residence. Any household member who was away for six months or more would be recorded as an

out-migrant. Similarly, anyone who moved into the household and intended to reside in the household for six months or more was considered an in-migrant.

At each round of the survey, the enumerators revisited the same households to record any changes in status during the last six months: changes in marital status and pregnancy status, births, deaths, in-migration and out-migration. Newcomers to the household, that is newborn babies and in-migrants, were added to the household questionnaire. A new questionnaire was used for any new household that had migrated into the sampled village. For any household migrating out of the sampled village, the relevant code for out-migrants was recorded for each member of the household in question.

In order to distinguish between different vital events, a separate code was assigned to each event. These codes were: 10 for a usual resident, 11 for pregnant, 12 for giving live birth, 13 for giving still birth, 20 for newborn, 21 for newborn and migrated out, 22 for newborn and died, 30 for in-migrated, 31 for in-migrated and pregnant, 32 for in-migrated and gave birth, 34 for in-migrated and died, 40 for deceased, 50 for out-migrated, 51 gave birth and out-migrated. To record changes in vital events, enumerators had only to record the relevant code in the column for that particular round.

Data entry procedures were written in such a way that those recorded as new born or in-migrant in one round were automatically coded in the next round as usual residents. Similarly, those recorded as deceased or out-migrant in one round were also automatically assigned a new code in the next round to identify that they were no longer usual residents. This was to ensure that each vital event was recorded only once.

2. 2. 3. Data limitations

The first data limitation is that the sample size of 126,587 persons is small, in relation to the size required for the accurate measurement of rare events such as deaths, particularly by age and sex. Clearly, for sub-national population estimates, sampling errors may be large. Therefore, only estimates for broad divisions of the population are possible. The estimates at best could refer to the national population and to regional and other broadly classified populations, and not to subpopulations smaller than these. Whilst these are subject to sampling errors, this shortcoming is reduced by the use of data for three rounds which cover a period of 18 months.

The second limitation concerns the lack of socio-economic variables such education, employment, income or access to amenities which could serve as proxies for socio-economic status and are widely used in the study of mortality differentials. In addition, socio-economic variables serve as indicators of knowledge and use of medical services, and since income is closely linked to occupation and education, in many societies where people rely on private medicines, it can affect the ability to use medical provision (Hobcraft et al. 1984: 219). The MVSS was not designed for a comprehensive demographic study involving the analysis of differentials. In addition to age, sex and marital status, the socio-demographic information contained in this data set is therefore limited to a few variables, namely, region, urban-rural place of residence and ethnic group. In order to capture the importance of the different types of agricultural production in different ecological systems, an additional variable, agro-ecological zone, was created at the stage of data organization and tabulation. This served as a proxy for type of livelihood, productivity and availability of food, access to transportation and communication and also for environmental hazards resulting from terrain elevation.

A third limitation is the failure to construct a data set from the whole six rounds of the survey. Only data from Round 2 to Round 4 are usable. After thorough assessment of the data set, it was found that death data from only Round 2, Round 3 and Round 4, which cover the period from 1 January 1989 to 30 June 1990, are reliable enough for the purpose of studying mortality for the country. For an unexplained reason, the number of demographic events occurring during the period from baseline to Round 1 are very small, less than 50 per cent of the number in subsequent rounds. Data for Rounds 5 and 6 are not available for many major provinces such Luangphrabang, Bolikhamxay, Savannakhet and Champassack because of software problems, precluding their use.

A further limitation of the data set is that reporting of age is not accurate enough for the estimation of infant and child mortality, as the survey asked only the occurrence of events during the last six months and not the timing of the event. In addition, as noted earlier, the degree of under-reporting of deaths among children under five years of age is reported to be high (D'Souza, 1993). This is the reason why these data are used only for the estimation of adult mortality.

2. 3. Data evaluation

Data collected from censuses and surveys in developing countries are often affected by errors such as inconsistencies, under-reporting of events, digit preference and age misreporting. Data obtained from the MVSS are no exception.

First, the original data set was edited for internal inconsistencies. Second, population size and number of vital events, distributed by age and sex, were examined to detect possible coverage errors in each round. This led to the creation of a new data subset on which the analysis is based. This data subset was evaluated for accuracy and reliability by examining the accuracy of age reporting and the age-sex distribution.

2. 3. 1. Data inconsistencies

One important source of error in the data set is data inconsistency. With no previous experience in the conduct of the demographic multi-round survey on the part of the survey undertaking organization in Lao PDR, it is not unusual to expect that the MVSS data would be to some degree affected by non-sampling errors. The Baseline survey and Rounds 1 and 2 used separate questionnaires for each round, but this was found to present problems related to high costs of printing questionnaires, time-consuming enumeration and data entry, as repeated household information had to be entered in each round, and difficulties in data management and in keeping track of households. A new questionnaire containing columns to record information for the whole six rounds of the survey in one sheet was introduced from Round 3. This created the need for retraining, manual copying of data from the old questionnaires to the newly developed one, and the re-establishment of a new database and the related data conversion. The whole process would undoubtedly have introduced some mistakes in copying. Furthermore, errors would have been introduced by keystroke errors during data entry.

The examination of data revealed a number of inconsistencies in the data set. However, the number of these data inconsistencies was very small, slightly above a thousand cases out of 152,138 cases in the original data set of the MVSS, and mostly involved cases of out-migrants.

These inconsistencies mainly stem from coding errors either made by the enumerators during the recording of the interviews in the field or by operators during the data entry process. For example, the code for urban was 1, and for rural was 2. While a whole village should have been coded as rural, for example, there were some cases coded as urban, or other codes, besides 1 or 2, were found in a number of cases.

These were edited by referring to the relevant codes of other households in the same village.

In the original data set, codes for ethnic groups were 1 for Laoloum, 2 for Laotheung and 3 for Laosoung. However, codes greater than '3' were also found in some cases and they were corrected according to the relevant codes of the other persons in the same household. Fortunately, this kind of coding error did not occur to the entire household, it was found only in some individual cases.

Another kind of inconsistency was found in a number of cases where codes for sex other than 1 for males and 2 for females were found. As the data set does not contain names and titles, this could only be corrected for cases where there was either a code specifying the relationship to the head of household as the wife or a code specifying the person as pregnant , in which case the code for female was assigned. Otherwise, cases with wrong gender codes were set as missing values. There were less than ten cases of such inconsistencies.

For vital events, a very small number of cases were given codes outside the range of codes preset for each vital event. All these cases were set to missing values since it was not possible to determine the exact event. There were no cases in Round 1, eight in Round 2, 11 in Round 3 and 10 cases in Round 4.

In addition to the above mentioned errors, inconsistencies also arose from illogical sequence in coding. Codes for events such newborn, deceased, in-migrant and out-migrant occurring in any particular round should be automatically changed by the data entry program to other codes in the following round in such a way that distinction can be made between events occurring in the previous round and those occurring in the current round, so that numerators and denominators for the calculation of demographic rates can be correctly derived. For example, a death coded as 40 in Round 2 would be

automatically coded as 72 in subsequent rounds in order to specify that this person is no longer in the sample population and to clearly distinguish this death from deaths occurring in these subsequent rounds. In this way, both the correct population and no duplication of death recording were to be assured.

However, in a number of cases these automatic codes were not entered, so that the original event was repeated, or the automatic code occurred in one round but the code for the original event was resumed in the following round, probably through some kind of mishandling of the data entry program by data entry operators. Thus, duplication of deaths occurred where a person coded as deceased in Round 2 was coded again as deceased in Round 3 and Round 4, instead of being assigned a code specifying they were no longer in the sample. There were only five cases of duplication of deaths in Rounds 3 and 4. These cases were edited to indicate that they were no longer usual residents. In the case of mortality analysis here, it is especially important to have the correct number of persons in the population and no duplication of deaths.

Some cases were coded in Round 1 as usual residents but coded as in-migrants in subsequent rounds. The numbers of these cases were 1,046 in Round 2, 315 in Round 3 and 572 in Round 4. These incorrect in-migrant codes were converted back to usual resident codes. There were also cases coded in one round as out-migrant, but as usual resident or out-migrant in subsequent rounds.

2. 3. 2. Coverage of events

It was found that the data contained a disproportionate number of deaths among in-migrants, in other words cases where the person was reported to have both in-migrated and died during the six-month period covered by a survey round. These cases are referred to here as 'dead migrants'. Table 2. 2. presents migrants and dead migrants as percentages of the total population and total deaths, respectively. It reveals that for all

ages, the ratio of the dead migrant percentage to the migrant percentage is 3.3 for males and 2.9 for females. For both sexes, the contribution of dead migrants to total deaths in relation to the contribution of migrants to total population is highly disproportionate at young ages and consistently high at ages below 60 years old, except for females in the age group 30-34 and in age group 45-49 where no dead migrants are reported.

Among those reported as dead migrants, it is probable that some were actually in-migrant deaths, but that many are due to reporting error. It is likely that absent household members who died were reported by the household head as dead migrants because of the need to account for deaths in the community and the importance of death in Lao society.

Table 2.2. Migrants and dead migrants as percentages of total population and total deaths, respectively, and ratios of dead migrant percentages and migrant percentages by sex, MVSS, 1990.

Age group	In-migrants as a percentage of total population		Dead migrants as a percentage of total deaths		Ratio of dead migrant percentage to migrant percentage	
	Males	Females	Males	Females	Males	Females
1-4	4.2	4.3	22.9	22.5	5.5	5.2
5-9	2.7	2.8	9.9	9.8	3.7	3.5
10-14	3.1	2.7	22.0	23.8	7.1	8.8
15-19	5.3	5.8	37.1	18.5	7.0	3.2
20-24	11.2	6.7	45.5	25.6	4.1	3.8
25-29	9.1	4.7	40.0	22.6	4.4	4.8
30-34	4.9	3.1	24.0	4.0	4.9	1.3
35-39	4.2	2.7	15.0	15.0	3.6	5.6
40-44	2.5	2.2	14.3	5.9	5.7	2.7
45-49	2.6	1.9	5.3	0.0	2.0	0.0
50-54	2.1	2.1	2.8	5.6	1.3	2.7
55-59	1.8	2.0	5.6	3.5	3.1	1.8
60-64	2.3	2.8	2.4	7.4	1.0	2.6
65-69	2.2	3.0	2.8	4.0	1.3	1.3
70-74	2.3	2.9	3.1	2.7	1.3	0.9
75+	2.3	3.3	1.6	5.2	0.7	1.6
Total	4.2	3.7	13.7	10.8	3.3	2.9

Source: MVSS data file, whole sample.

It is also likely that some dead migrants in the adolescent ages were usual residents but were not reported as such for fear of military conscription. However, when a death occurred, a religious ceremony had to be performed at the bereaved household and the relevant authority had to be informed of the event. Hence such deaths were most likely to be reported in the survey as dead migrants.

In order to eliminate the bias introduced by dead migrants, all migrants were excluded from the analysis. This practice also removes the possibility of bias that might be introduced by real migrational effects. It is normally found that migrants in Lao PDR are those who are both socially and economically disadvantaged and who are looking for jobs or new land, and their morbidity and mortality rates tend to be significantly higher than those of people who are permanent residents (UNICEF, 1996). The data subset thus constructed includes only people who were usual residents throughout the 18-month period under study.

2. 3. 3. Age reporting errors

Problems with age misreporting are always present in data from developing countries (Shryock et al., 1976; UN, 1982; Timaeus, 1991). In a country where there is no complete civil registration system and where the majority of the population have little or no level of education, it is not unexpected to find the data on age to some extent affected by age misreporting.

The MVSS recorded age in the baseline survey or, for in-migrants and persons previously omitted, at the relevant round. Only age at last birthday or age in completed years was asked. For all usual residents, one year was added to the recorded age at Rounds 2, 4 and 6. The reason why the MVSS did not ask exact date of birth is that, except for a few highland tribes, date of birth has no cultural importance in the daily life of the Lao people and is largely unknown.

The majority of the Lao people are Buddhist and therefore rely on the lunar calendar for reckoning seasons and times for religious functions, of which there is one

in each of the twelve months of the year. Lao people also adopt animal years. Each year has its own animal name; for example the year of the dragon, of the snake, of the horse. There are twelve animal years in one cycle. Most people in the rural areas always refer to the animal name of the year in recalling major events in life. People usually report the timing of a birth or a death by referring to the animal year plus the season, rainy or dry. As part of the supervisor's and enumerator's manuals, a table for conversion of animal years to calendar years was provided.

Age reporting is expected to be more accurate in urban areas as urban dwellers are likely to be more educated, and the modern calendar is effectively used in every sphere of life. It is only for the last two generations or so that admission to primary school in the modern schooling system has required parents to produce birth certificates of their children, though this practice does not cover all areas of the country. Age reporting is also more accurate among highland people where date, month and year of birth are important as they are used for matching the astrological signs of prospective husbands and wives. Date of birth is also used in the rituals performed during the course of sickness.

Overall, it is therefore expected that there would certainly be a degree of age misreporting, both from respondents not knowing their age and from the tendency to round up age to the next complete year. The extent of age misreporting is further examined in Sections 2.3.4 and 2.3.5.

2. 3. 4. Digit preference

Where respondents and enumerators were obliged to report ages without the actual knowledge of day, month or year of birth, digit preference in age reporting is likely to be present. Digit preference results in age heaping and this is usually measured by the Myer's Index, which is an estimate of the minimum proportion of persons in the population for whom an age with an incorrect final digit is reported. Almost equal numbers of population are expected at each terminal digit for a non-distorted age

distribution, and therefore the percentage of each digit should be 10 per cent of the total population. The deviation of the percentage for any digit from 10 per cent measures the preference, if more than 10 per cent, or the avoidance, if less than 10 per cent, for that specific digit. One-half the sum of these absolute deviations from 10 per cent gives a summary index of digit preference, called Myer's Index. If there is no age heaping, the index would approximate zero (Shryock, et al., 1976:207).

Table 2. 3. gives the percentage distribution of the population in each terminal digit and the deviation from 10 per cent. The Myer's Index is computed over the age range from 10 to 89 years old. The age distribution of Round 1 (excluding all migrants) is used as the age distribution recorded in the Baseline and Round 1 is basically the same for only a six-months interval has elapsed. Moreover, more complete coverage was achieved in Round 1 than in the Baseline.

Table 2.3. Percentage of population estimated in each terminal digit, deviation from 10 per cent at each terminal digit and Myer's Index, MVSS Round 1.

Terminal digit	Per cent of population		Deviation from 10 per cent	
	Males	Females	Males	Females
0	12.28	14.33	2.28	4.33
1	7.80	8.27	-2.20	-1.73
2	8.93	9.03	-1.07	-0.97
3	9.28	8.69	-0.72	-1.31
4	8.04	7.92	-1.96	-2.08
5	12.72	12.71	2.72	2.71
6	10.42	9.92	0.42	-0.08
7	9.52	8.82	-0.48	-1.18
8	12.23	11.69	2.23	1.69
9	8.78	8.62	-1.22	-1.38
Myer's Index	**7.65**	**8.73**		

The Myer's Indices of 7.65 and 8.73 for males and females respectively suggest that age heaping is present in the MVSS data and that digit preference is more common in females than in males. The ending digits for their ages that males tend to report their ages are 5, followed by 0, 8, and 6 marginally. Meanwhile the digits that they tend to

avoid are 1 and 4 and to a lesser extent 9 and 2. The digits most preferred by females are 0, 5 and 8, in that order, while they tend to avoid 4, 1, 9, 7, 3 and 2.

The preference for 8 as a terminal digit could be the result of respondents reporting year of birth as a year ending in zero, for example 1940, 1950 and so on, which would result in an age ending in the digit 8 since the Baseline Survey was conducted in 1988. Whilst digit preference clearly exists, the problem is reduced by grouping data into five-year age groups. For the present analysis, where data on deaths and population are from the same source, digit preference will have minimal or no effect on mortality rates, because digit preference tends to average out over 5-year age groups.

2. 3. 5. Evaluation of the age distribution of the population

This section compares the age distributions of the non-migrant subset, the MVSS sample and the 1995 Census. Two comparisons are made. The first concerns the MVSS sample and the 1995 Census. If the MVSS is representative of the total population of the country, these two age distributions should be similar. Hence, their comparison will reveal the ages where possible sources of bias are greatest. Second, comparison of the subset with the MVSS sample indicates the extent to which the subset age distribution is biased by the exclusion of migrants, again indicating the ages at which possible sources of bias are greatest. However, whilst differences exist it should be noted that any potential biases are minimized by the fact that the deaths relate directly to the population under study. Differences in the age structures will have no effect unless there is a mortality differential between the population that is common to both data sets under comparison and the population that is not common. Comparison of the three age distributions is seen in Figures 2.1. and 2.2.

The 1995 census was a *de jure* census and was asserted to be of reasonable quality (NSC, 1995c). The main difference between this census age distribution and the MVSS sample is found at ages 15 - 24 for males and 30-34 for females. The difference

Figure 2.1. Comparison of proportion of age distribution, males.

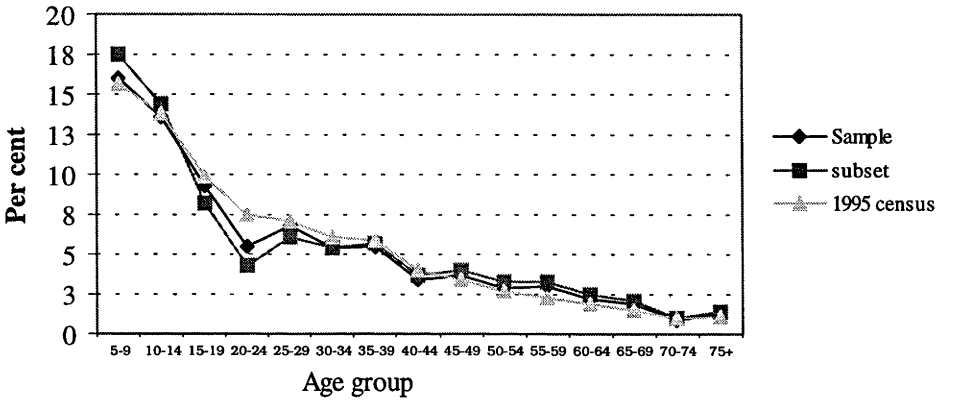
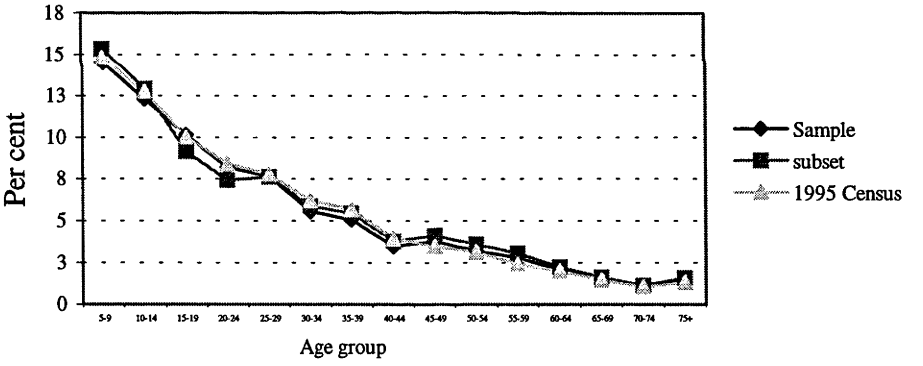


Figure 2. 2. Comparison of proportion of age distribution, females.



Source: Table A. 1, MVSS sample and subset, 1990.
1995 Census data obtained from the National Statistical Centre, Vientiane, Lao PDR.

in the age distribution of the 1995 census and that of the MVSS sample is due to the differences in the definition of population used for usual residents which entails slight differences in population covered; to the under-reporting of population in the MVSS for avoidance of conscription; and to the migration of young adults. The differences in the age distributions are less marked in the case of the female population. The issues

causing the differences between the observed age distributions and those of the 1995 census are discussed in Section 2. 3. 6.

Comparison of the age distribution of the population in the sample subset with that in the whole sample shows that there are marked differences at ages 5 to 29 for males and at ages 5 to 24 for females, and that there are slight discrepancies at ages 40 to 55 for males and at ages 35 to 55 for females. Overall, there appear to be no big differences in the age distributions of the whole sample and subset, the number of migrants is relatively small, averaging in each round only 2,519 for males and 2,324 females.

Higher population proportions observed in the whole sample relative to the subset at ages 15-29 for males and at ages 15-24 for females are the result of the exclusion of migrants, who at these ages account for larger percentage shares of the total number of migrants. Table 2.2 shows that migrants make up a greater proportion of the whole sample at these ages than at other ages. The share in the total number of migrants at ages 15 to 29 years old alone accounts for 42 per cent of both males and females. When these migrants are removed from the sample, the population proportions at these ages naturally become smaller while the proportions at other ages increase. In particular, for age groups 5 to 14 for males and females, the subset proportions are noticeably higher than at other ages, as the population in these two age groups is already large relative to subsequent age groups and they have relatively small shares of migrants.

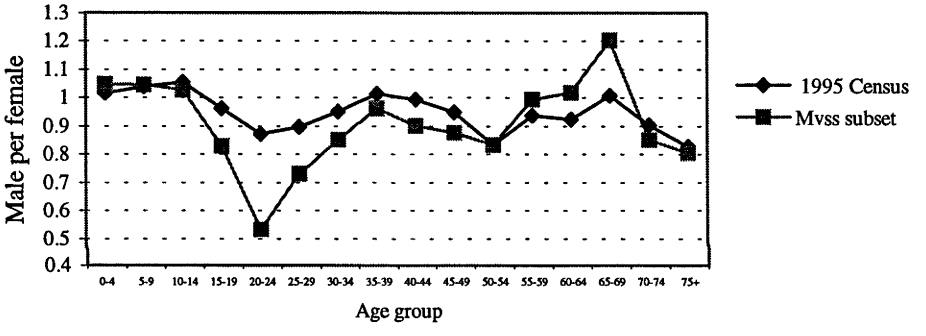
2. 3. 6. Evaluation of sex ratios

The sex ratio is defined here as the number of males divided by the number of females. Sex ratios by age follow a rather typical pattern unless migration or other factors distort the sex composition of the population under study (Ueda, 1987:36). In almost all populations, the sex ratio at birth is greater than 1.0 but less than 1.10. As it is

found in most societies that male mortality is higher than female mortality at all ages, sex ratios fall from a high level at birth to a level as low as 0.3 in people aged 75 and over. The sex ratio attains a balance at 1.0 at some age during the age interval between 15 and 45 (WHO, 1977:20).

Since data from the MVSS subset that are used for the analysis of adult mortality, sex ratios of the MVSS subset are considered here in relation to those observed in the 1995 census, for a clearer picture of how atypical the MVSS subset is of the total population of Lao PDR.

Figure 2. 3. Comparison of sex ratio between the MVSS subset Round 1 and the 1995 Census, Laos.



Source: Table A. 1, MVSS sample and subset, 1990.
1995 Census data obtained from the National Statistical Centre, Vientiane, Lao PDR.

Figure 2. 3. presents sex ratios for the subset as recorded in Round 1 of the MVSS and for the 1995 census. It is seen in Figure 2.3 that the sex ratios observed in the 1995 census do not follow the theoretical pattern described above. The atypical pattern of sex ratios in the Lao population can be attributed to propensity of young men to try to avoid military conscription and to migrate out of country for work among. In the 1995 census, a considerable number of young men were absent and some were excluded from the census because they were migrants and did not satisfy the six-month

qualification for inclusion as usual residents. At higher ages, the observed pattern is probably the result of different patterns of age misreporting for males and females.

The sex ratios observed in the MVSS subset follow a broadly similar pattern to that of the 1995 census, but with differences seen in the deeper troughs and higher peaks of the MVSS subset. A striking difference is the deeper trough in the MVSS subset sex ratios at ages 15-34, with the age group 20-24 recording the most serious deficit. This is largely due to the exclusion of migrants from the MVSS subset, most of whom are young men.

Following a peace treaty signed by Lao PDR and Thailand at the end of 1987, large numbers of young men in their late teens and twenties illegally crossed the border to work as migrant workers in Thai industries; 10 out of 17 provinces in Laos share the international border with Thailand, and entry to Thailand for Lao people is quite easy. Agricultural activities in Laos are mainly seasonal, resulting in a high rate of under-employment in rural areas (NSC, 1995b). Further, employment and higher educational opportunities are scarce for most rural people. Manufacturing industries are few and centered in the capital of the country only.

Other contributing factors were different population coverage and intentional omission. Coverage of households in the two data sources was different. The MVSS included only people who were usual residents of individual households, defined by a six-month residence qualification. Residents of all other types of households were excluded, that is males and females who live in state boarding houses, collective households, military and police barracks, and any other form of collective residence. The majority of such people are young adults, mostly aged from 15 to about 30 years old, who are normally students, young and single workers or those in the military and police who are still single and have not formed their own households. In all parts of the

country, it is normally found that the tenants of collective households of all sorts are single males. The number of females in this group is much smaller than that of males, because few females pursue education beyond primary level or outside their own village. As has been shown by the 1985 census, the higher the level of education the smaller the proportion female among students (SSC, 1992). Also, the female share in government services or state run enterprises is markedly less than the male share. Married-couple families living in collective households are also omitted from the MVSS, but their number is likely to be insignificant. In contrast, the 1995 census covered usual residents of all kind of households including collective households, student boarding houses, military barracks and police living quarters, and people studying and working for the government abroad.

Intentional omission of population resulted from fear of being conscripted into the army. In addition to migration for work this omission also contributes to the more marked deficit observed among young men in the MVSS as these people were excluded from the MVSS. In the light of the border war with Thailand which had just cooled down when the MVSS started, heads of households interviewed in mid-1988 would tend not to report male members of the household, aged from 17 to about 30 years and who were not studying or employed in a state institution or enterprise, for fear that these young men would be coercively drafted for military service. Such under-reporting would be more widespread in rural areas, because exemption from military recruitment on grounds of education or employment is almost impossible, except by out-migration, owing to the lack of higher educational institutions, state institutions and enterprises in most rural areas. In contrast, females in adolescent age groups were less likely to be omitted by heads of households in the enumeration of household members as there was almost no risk of their being conscripted into the military.

The increased sex ratios observed from ages 55 onward in both the 1995 census and the MVSS subset are likely to be the result of age misreporting among males. As pointed out earlier, it is only during recent times that birth certificates have had any purpose in the life of people, and older generations, especially in rural areas, are probably unaware of their true ages. There is a propensity for older men to inflate their ages, as seniority and old age bring respect and status in the society. This is not true of women, resulting in high sex ratios at these higher ages. In addition, sampling errors resulting from the small number of cases at higher ages in the MVSS subset may have contributed to the erratic sex ratios.

2. 3. 7. Summary

The main differences between the age-sex distributions of the MVSS subset and the 1995 census can be attributed to the exclusion of migrants from the MVSS subset, the different coverage of households, and a greater tendency for omissions related to fear of military conscription in the MVSS.

It should be noted that irregularities in the MVSS subset age-sex distribution will not affect mortality rates as long as there is no bias due to differential mortality between migrants and non-migrants, because the population and death data are directly related . The possible bias in mortality can only occur if the mortality experience of the migrants is largely different from that of the non-migrants.

Whilst there are undoubtedly age reporting errors in the data, these are not extreme and their effect is again minimized by the fact that the population and death data are linked. Only systematic age under- or over-reporting will affect the estimates obtained, and this will be minimal at ages where the mortality curve is relatively flat. Only at higher ages would systematic age over-reporting in males affect the survival

probabilities obtained, leading to underestimation of mortality. This minimization of bias is a major advantage of using linked data from the MVSS for this analysis.

2.4. Estimation of adult mortality

2.4.1. Methodology in adult mortality estimation

Age-specific death rates can be obtained by either direct or indirect methods. In this analysis, direct calculation of the rates is employed. As detailed below, the MVSS data are such that direct calculation is believed to be not only appropriate but also more accurate than indirect estimation.

Whilst indirect methods are commonly used in mortality analysis in countries where data are deficient, their use depends on assumptions that are not met in the Lao PDR. From the above discussion and examination of the age distribution, it is clear that the population is neither stable nor closed to migration. Although there is no evidence of fertility decline, the population is not stable because mortality has clearly declined. Furthermore, the population is not quasi-stable because the mortality improvement has not been gradual.

The use of indirect techniques for mortality estimation would also be inappropriate and misleading because it would rely on a mortality model that may not reflect the actual mortality situation of the Lao population. Indirect techniques for adult mortality estimation heavily rely on whether the assumptions underlying the model are applicable to the population under study (McDonald, 1982:514). Even the indirect techniques for detecting under-reporting of deaths and estimating adult mortality, which do not depend on model life table mortality patterns such as the Brass Growth Balance and Preston and Coale techniques (UN, 1983: 129-146), cannot be applied owing to the violation of stability and non-migration assumptions.

Other indirect techniques depend on models to estimate adult mortality from child mortality (Blacker et al., 1985). Even though estimates of infant and child mortality for Lao PDR can be obtained from other sources, the use of this technique can prove to be highly misleading (Timaeus,1991: 553) and would be expected to be so in the Lao context. Blacker et al. (1985) showed that the age patterns of mortality in a number of African countries have been found to differ greatly between populations, and that the relationship between child and adult mortality in Africa often differs from that in any of the families of the Princeton or UN model life tables. This would be the case for Lao PDR.

Direct estimation of mortality is especially appropriate for linked data such as those analysed here. The fact that the population and death data come from the same source removes the problems arising from age misreporting and age-selective omissions when two separate sources are used.

In the Lao context, direct estimation of adult mortality is also believed to be free of bias due to under-reporting of deaths. Owing to cultural circumstances, under-reporting of deaths is very unlikely. With the exception of the death of very young children, death is an important event, which requires various religious ceremonies before the corpse can be cremated or buried. The corpse is often kept for some days, depending on the financial situation of the family concerned, but at least two or three days, awaiting the arrival of next-of-kin and other relatives who live elsewhere. During this time religious ceremonies have to be performed, and this normally involves almost the entire village who come in turn to provide help at the bereaved household. In most cases of death from violence, the body has to be placed at a temple overnight for religious ceremonies before the burial ceremony can be held next day. In such cases, it

is not auspicious to hold the ceremonies at home, and it is imperative to report the death to the local authority for investigation.

Most importantly with regards to the completeness of death enumeration, it is not legally feasible to have a dead body and a gathering of people for ceremonies in one's house without informing the village authority, who would also attend to the event and in most cases provide some sort of relief or consolation to grieving household members. It is thus highly unlikely that a death would not be reported to the enumerators. Therefore, adult mortality is likely to be completely reported.

Further, since the data are multi-round survey data, they are likely to yield reliable results. It has been argued that longitudinal studies (multi-round survey and surveillance) yield more reliable data than do single-round surveys for the study of age patterns of mortality, mortality in old age, and mortality differentials (Timaeus, 1991:558). The adult mortality rates derived here are the mortality experience followed throughout the survey in which vital events for each household were recorded in a single schedule designed to cover the whole six rounds of the survey, therefore duplication of enumeration of deaths is not likely. These estimated mortality rates are believed to be the best estimates that can be derived from the empirical data so far available for Lao PDR.

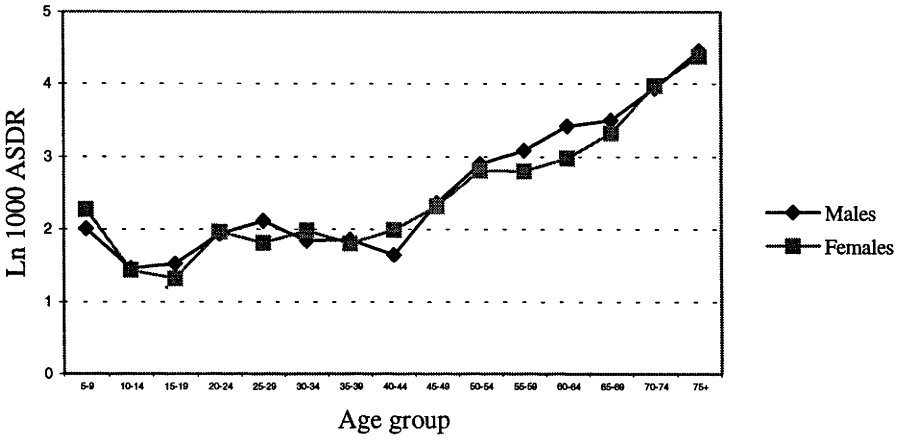
The population used as the denominator in the calculation of mortality rates is the mid-period population, that is the mean population of Rounds 1 and 4. The numerator is the annual average number of deaths, that is mean number of deaths recorded in the three rounds multiplied by two.

2. 4. 2 Adult mortality patterns

The age- specific death rates (ASDRs) by sex for the Lao population derived from the MVSS sample subset plotted against a logarithm scale is shown in Figure 2.4.

Table 2. 4. provides the ASDRs by sex per 1000 population and ratios of male to female death rates.

Figure 2. 4. Age-specific death rates by sex, Lao PDR, 1990



Source: Rates computed from table 2. 4, MVSS subset, 1990.

Table 2.4. ASDRs by sex and sex mortality ratios, Lao PDR 1990

Age group	ASDRs per 1000 population		Ratio male/female death rates
	Males	Females	
5-9	7.46	9.75	0.77
10-14	4.34	4.21	1.03
15-19	4.60	3.76	1.22
20-24	6.95	7.17	0.97
25-29	8.32	6.15	1.35
30-34	6.33	7.26	0.87
35-39	6.41	6.12	1.05
40-44	5.22	7.35	0.71
45-49	10.66	10.21	1.04
50-54	18.23	16.71	1.09
55-59	21.84	16.48	1.33
60-64	30.63	19.70	1.55
65-69	33.20	27.83	1.19
70-74	51.72	53.25	0.97
75+	86.68	80.40	1.08

Source: Computed from data provided in the Appendix, Table A.2.2, analysis of the MVSS subset, 1990.

It can be seen from Figure 2.4. that for males, mortality at ages 20 to 39 is elevated, particularly at age 25-29. This phenomenon is probably the result of a high level of accidents and the risky working environment which these young males

experience, particularly those who during most production seasons live in the fields, risking exposing to the malarial and other water-borne diseases. It is rare for people who sleep in the fields to use mosquito nets or drink boiled water, and Lao PDR is a country with the highest incidence of malarial endemic and infectious diseases (UNICEF, 1992), especially in the low plateaus and hills. Owing to the types of vegetation and the numerous stretches of stagnant water, many areas of the southern plain are malaria-infested. In 1990, the malarial infection rate in three northern provinces was about 17 per cent compared to 52 per cent in the two southern provinces (UNICEF, 1992:56).

In addition, road accidents, and the explosions of the unexploded ordnance left during wartime in the rice fields and other labour accidents, are suspected to be very high. It is also possible that some of the men in their 20s did not migrate out of the village at all owing to their ill-health, or returned to their village before Round 1 with certain kinds of illness. Higher male than female mortality in the age group 15-19 is more likely to be associated with a high rate of motor accidents among males in this age group than with any sex-specific diseases. The irregularity in the ASDRs found at higher ages for males could be due to sampling fluctuation because of increasingly smaller numbers as age advances.

At age 5-9, the mortality of girls is markedly higher than the mortality of boys; this could stem from two possible causes. One is the likely sex bias in favour of boys in the family allocation of food and health care among patriarchal minorities ethnic groups, as in the case of rural Bangladesh (Chen et al., 1989). Also, rural Lao girls are normally timid and subservient in nature and it is also possible that when not feeling well they keep their suffering to themselves until the sickness becomes very serious.

The other cultural explanation is that boys of this age are more likely than girls to wander around in fields and forests where they have the advantage of having more

nutritional intake in addition to what that provided at home, from wild insects and small game, root crops and wild fruits and vegetables. Meanwhile girls at these ages are more likely to remain at home taking care of younger siblings and helping with household chores, which deprives them of the chance to find additional food. For rural Bangladesh, Chen et al. (1989) found that the level of malnutrition is substantially higher among girls than boys. The higher female death rate at this age cannot be attributed to a cultural preference for sons over daughters, because son preference does not exist in Lao society, except in the area of education where parents tend to favour higher education for males rather than for females (Maroczy, 1986).

During the reproductive life span, instead of lower mortality rates, levels of mortality for females in the age groups 20-24, 30-34 and 40-44 are higher than those for males, while the advantages over males in other age groups are quite small. High mortality is also experienced by females in the age group 20-24, probably due to high maternal mortality among young first-time mothers who give birth for the first time, especially in rural areas where help from trained midwives is usually absent. Considering the whole reproductive span together, the observed high mortality levels obviously reflect the prevalence of high maternal mortality and the general lack of maternal health care(MCHI, 1994; NSC/LWU, 1995). The higher levels of mortality for females found in the age groups 30-34, 40-44 and 70-74 could be in part affected by the problem of age misreporting as well and possibly at 70-74 sampling variation.

On the average, Figure 2. 4. and Table 2. 4. point to the fact that for ages under 50, the gap between male and female mortality is very narrow, except for age groups 15-19 and 25-29 where sex mortality differentials are quite pronounced. In high mortality regimes, the advantage of females over males longevity is not substantial (UN, 1988b),

and in fact data quality itself raises doubts about the authenticity of such sex differentials (UN, 1982: 120).

The rates show a female mortality advantage from ages 50 to 69. Excess male mortality in this age range could be attributable to the more hazardous life style and behaviour of the male population, especially the long period of smoking and heavy drinking of alcohol in most Lao males. For the population aged 70 and over, because of the small number of cases in the data and hence inducing sampling fluctuation, mortality differentials between the two sexes cannot be adequately concluded.

2. 5. Summary

As in most developing countries, the absence of a complete vital registration system in Lao PDR has so far impeded knowledge of the age pattern of adult mortality. The Multi-round Vital Statistics Survey provides valuable data for the direct measurement of adult mortality. This is the first attempt to measure mortality from empirical data. The sample size of the MVSS subset is adequately large for the analysis of adult mortality. Assessment of data and correction for inconsistencies were made before it was found that the original data set was overwhelmed with the problem of dead migrants. To get rid of this dead-migrant effect on mortality estimates a data subset was constructed, consisting purely of usual residents in the sample. Although age distribution is found to be atypical, this does not pose problems for the reliability of the estimates as data on both population and deaths are from the same source.

Adult mortality estimated above is therefore based on data on non-migrant usual resident for the period of 18 months; the estimates are free from migrational effects. The estimates are in a sense biased, because by excluding migrants they are not representative for the entire population and they might be slightly optimistic, as migrants seems to be the most vulnerable and least advantaged people,.

After high levels of mortality at the very early ages mortality drops to its lowest level at around age 10-19. Instead of remaining approximately at that level thereafter, mortality of people in their twenties is especially high, particularly for males. A high prevalence of accidents, hazardous working and unfavourable living conditions combined with unhygienic and health-debilitating lifestyles, are suspected to contribute to such observed mortality patterns. Mortality rises remarkably sharply after age 50 for males and females alike.

Differentials in adult mortality are examined in Chapter 5. Underlying factors responsible for mortality in Lao PDR are thoroughly examined in Chapter 8.

Chapter 3

Infant and child mortality: levels and trends

3. 1. Introduction

Although child mortality is considered to be a sensitive reflection of the portrait of the health problems and socio-economic development of a country and a very useful indicator for setting target groups in health planning and policy making, very few developing countries possess a complete vital registration system which can provide reliable infant and child mortality data (United Nations, 1982; 1985). In addition to not having a civil registration system in place, until quite recently the infant and child mortality situation in Lao PDR remains only guesswork.

Evidence from other studies in various parts of the globe suggests that there were great reductions in the levels of infant and child mortality in American, Asian and African countries from the period 1960s to mid 1980s (Hill and Pebley, 1989; Cleland et al., 1992; Rutstein, 1983). Although in the early 1980s some authors such as Gwatkin (1980), Ruzicka and Hansluwka (1982), Arriaga (1981), Preston (1985), Palloni (1985), Caldwell (1986) express considerable concern that the pace of mortality decline has slowed down in the mid-1960s and 1970s after an initial period of rapid decline following WWII, data from more than sixty countries in the developing world do not support such concern (Hill and Pebley, 1989: 668-672).

For Lao PDR, the question arises as to whether or not infant and child mortality has declined in the face of the long lasting war and during the period of abject poverty following the liberation of the country when only a very limited degree of development reached the majority of the population. Environmental and ecological factors in Lao PDR also favour all-year round transmission of water-born and infectious diseases such

as malaria, lower respiratory tract and gastro-intestinal diseases (UNICEF, 1992; 1996) These diseases together with the prevalence of malnutrition among children and limited access to immunization and health care undoubtedly maintain infant and child mortality at high levels.

Available estimates of infant mortality for around 1990 range from 113 per thousand live births (NSC/LWU, 1995) to 125 per thousand live births (MCHI, 1994; NSC, 1995b). Estimates for more recent years are even more erratic, to such an extent that they are excluded from the published trends (NSC, 1995b: 90). Child mortality estimates also differ markedly from one source to another, from 49 per thousand alive at age one for the period 1984-94 (NSC/LWU, 1995: 65) to 65 per thousand children alive at age one (MCHI, 1994).

This chapter, using data obtained from the 1994 Lao Fertility and Birth Spacing Survey (FBSS), examines the levels and trends in infant and child mortality in Lao PDR. The following sections discuss the analytical approach used, the data set and the evaluation of the data. The examination of infant and child mortality levels and trends will then be discussed before arriving at the conclusion of the chapter.

3. 2. Methodology and measures

It is well established that the life table is a powerful actuarial tool for providing mortality indicators that are independent of the age distribution, usually life expectancy or the probabilities of surviving from one age to another (Trussell and Hammerslough, 1983: 2). The procedure used for the study of levels and trends in infant and child mortality in this chapter and for the study of differentials in Chapter 6 is the life table survival analysis. This procedure enables the analysis of survival intervals, that is the length of time between one event and another.

There is a fixed time reference of infant and children under study in the life table survival analysis. Infant and children are assumed to enter the analysis over the whole duration of the study. Some will die during the reference period and some will survive the end of the reference period. The survival times of children who die during the interval is measured as a length of time from birth to the time they die, which are actually age at death. Children who survive at the end of the study period have their survival times equate their ages at the time of the survey. Survival time used for infant mortality analysis is the length of time from birth to death before exact age one, and that for child mortality analysis is from age one to before exact age five. Some children will continue to the survey date but they have not yet aged one year or five, and later they may die before their first birth day or before their fifth birth day. These children are called censored cases in the analysis (Retherford and Choe, 1993). Time reference used in this analysis is from mid 1965 to mid 1994.

A statistical software for the analysis of life table survival called *'life table'* procedure is available under the *'Survival'* statistical procedure of the *SPSS* program (SPSS 7.5 for Windows). This type of survival analysis is appropriate for the study of time-interval variables, and it can handle censored cases correctly as it deals with length of time in the interval instead of just number or proportion of deaths during interval. Thus information on all births during the reference period can be used in the analysis without being restricted by the truncation of censored children from the study which will make sample size smaller and increase sampling errors.

The measures used for the analysis of infant and child mortality are those given by the following definitions. The infant mortality rate (IMR) is the probability of dying from birth to exact age 1, ${}_1q_0$. The child mortality rate is the probability of dying between exact ages 1 and 4 years old, ${}_4q_1$. The under-five mortality rate is the

probability of dying from birth to exact age five, ${}_5q_0$. The probability of dying in interval (t, t+i), $q_{(t)}$,is the number of deaths during the interval under study divided by the number of persons at the start of the interval, which is also called the number exposed to the risk of death. Without censoring it is expressed by: $q_{(t)} = D_{(t)}/N_{(t)}$, where t is the time of birth for infant mortality estimate and the first birthday for child mortality; $D_{(t)}$ is the number of children dying during the interval t and $t+i$ and $N_{(t)}$ is the number of children surviving at time t.

In dealing with censored data, the above expression becomes:

$q_{(t)} = D_{(t)}/N'_{(t)} - 0.5C_{(t)}$, where $N'(t) = N(t) - 0.5\ C(t)$ and where $N'_{(t)}$ is the number of children who are still alive at time t and $C_{(t)}$ is the number of children who were censored during the interval t to $t+i$, under the assumption that those who are censored are exposed to mortality risk for half the interval.

The probability of dying from birth to exact age five is computed by ${}_1q_0 + [(1- {}_1q_0)\ {}_4q_1\ ]$. For the measurement of childhood mortality and the study of childhood mortality differentials, ${}_5q_0$ is preferred to the infant mortality rate (Pebley and Hill, 1989; Palloni, 1990) as it covers accumulated mortality experience throughout childhood (UN, 1988a). This is important in the context of high child mortality in developing countries where as many as 50 per cent of all child deaths may occur after infancy (Hill, 1991: 368).

The *SPSS* 's *'life table'* procedure for survival analysis is considered to be a multivariate life table in which the influences of one or more independent variables on survival can be examined. The procedure provides a statistical test for the differences in surviving experience between categories of independence variables called Gehan (Wilcoxon) which was basically generalized from Mantel-Gehan test that relies on the hypothesis that two sample are the same, and the test compare every observation in the

first sample with every observation in the second sample. The survival experience for each category in this study is the experience considered from the first through the last age interval used in the study. The Gehan test is based on the ordering of the failure times, from earlier to later. Using this ordering, the Gehan test checks whether failure times of individuals in one group tend to occur earlier or later than failure times of another group. With the generalization by Gehan and Breslow censoring is allowed for in this test and comparison of more than two groups is also possible. If $p < 0.05$, the survival chances or levels differ significantly from each other at five per cent level (Cox and Oakes, 1984: 124-128; Retheford and Choe, 1993: 177).

3. 3. Data set

The Fertility and Birth Spacing Survey employed two questionnaires, the household and individual questionnaires. These questionnaires were pretested and modified as necessary (NSC/LWU, 1995). The household questionnaire was designed to list all usual members of the household. The information pertaining to each listed household member included relationship to the head of the household, sex, age and date of birth, education and marital status. This questionnaire was also used to identify those women eligible for the individual interview. The eligible women were defined as ever married women aged 15-49 years old.

The individual questionnaire obtained information on the respondent's characteristics such as date of birth, age, school attendance and highest level of education completed, literacy, media exposure, economic activities, and reproductive history, birth spacing knowledge and behaviour, pregnancy and breastfeeding, immunization and health status, marriage, fertility preferences and background characteristics of the husband including his school attendance and highest level of education completed and his main occupation (NSC/LWU, 1995).

3. 3. 1. Sample design and method of enumeration

According to the FBSS report (NSC/LWU, 1995), the sample for the FBSS was a national probability sample covering all 17 provinces and one special region of the country. The design was a two-stage stratified cluster sample. The sampling frame was the 1990 nation-wide population count of villages and the then current lists of households maintained by village heads.

At the first stage of sampling, after arranging administrative districts within each province in geographic order to ensure an adequate spread in the sample, villages were selected by systematic sampling procedure. All of the total 126 districts of the country were included in the sample. The second stage of sampling consisted of using systematic sampling to select a fixed number of 25 households from each sampled village.

In total, 6225 households were included in the sample, but only 6087 were successfully interviewed. The number of women eligible for interview was 5796, and 5787 women were actually interviewed. Thus responses rates for households and individuals were 97.8 and 99.8 per cent respectively (NSC/LWU, 1995).

The fieldwork of the FBSS was conducted during the period from 9 May to 22 August 1994. The FBSS was jointly conducted by the National Statistical Centre (NSC), the Lao Women Union (LWU) and the Maternal and Child Health Institute (MCHI). The supervisors were officials with at least a bachelor's degree working in these three institutions. Training of interviewers and supervisors was provided by the United Nations Country Support Team and NSC experts. It should be noted here, unlike the MVSS in which few enumerators and supervisors had any tertiary education, both the supervisors and enumerators involved in the FBSS have at least tertiary level training in the areas of statistics, medical science and women in development (NSC/LWU, 1995).

3. 3. 2. Construction of a childfile for the analysis of infant and child mortality

Together with information on fertility, women's characteristics and on knowledge about family planning, the FBSS data file also contains a child module consisting of a birth history of up to 15 children. In order to render these birth history data amenable to analysis, fifteen data sub-files had to be constructed, one for each birth order with the linking of child information to their mother's information by using certain identification and index variables. These fifteen files were then aggregated to form a file, called the 'childfile', which is the actual file used for the analysis of infant and child mortality. The 'childfile' contains a total of 23269 births.

3. 3. 3. Data evaluation

It should be born in mind that there are a number of possible errors in the data. Such errors are believed to be always present in birth history data obtained through surveys in developing countries (Hobcraft et al. 1984; Al-Kabir, 1984; United Nations, 1982, 1985). These errors include mother and child age misreporting, misstatement of age at death of a child, and child omission resulting from failure to recall and report births and deaths that occurred a long time ago. Checks for internal data consistency and data editing were carried out both in the field and at the headquarter of the survey office in Vientiane. After data entry, the data were again edited by supervisors on microcomputers using the Integrated System for Survey Analysis (ISSA), a database program especially designed for DHS data (Curtis, 1995). The resulting data were considered to be of adequate quality (NSC/LWU, 1995).

Another possible source of error encountered in demographic and health surveys is the under-reporting of deaths due to selective omission of births (Curtis, 1995). Selective omission result from the exclusion of women older than 45 or younger than 15 at the time of the survey, and births to these women were selectively excluded from the

survey, though their number is usually insignificantly small. If the number of selective omission is significant, it may give a false impression of the trends of fertility and child mortality (Al-Kabir, 1984:9).

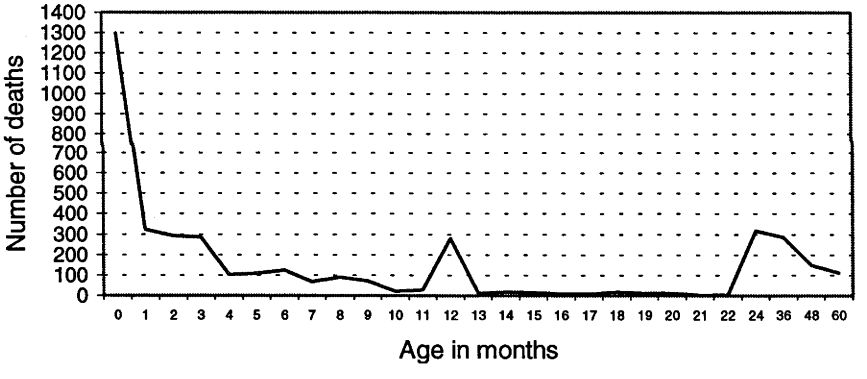
In the Lao context, women, particularly older women, may fail to report births which occurred in the relatively distant past or which have subsequently died. Due to high parity and recall lapse, when asked to list children ever born, older women with high parity tend to omit children who died during infancy or childhood. This is particularly true in the case of infant deaths that occurred shortly after delivery (NSC/LWU, 1995: 63) because the death of a newly born child is an unimportant event compared to the death of an older child or adult. Unlike adult death for which traditional formalities and religious ceremonies are required, the death of a new born child sometimes goes unnoticed by the relevant authority as the body would be buried without holding such ceremony. Therefore such events are often not mentioned. This will result in the underestimation of infant mortality.

Another important source of error in the analysis of infant and child mortality is the heaping of reported age at death at 12 months (Rutstein, 1985; Sullivan et al. 1990; Curtis, 1995). In the birth histories of the FBSS, age at death is reported in months up to two years and in years thereafter, as in most demographic and health surveys (Hill, 1991: 373).

Examination of the distribution of age at death reported in the FBSS data, shown in Figure 3.1, reveals that heaping at 12 months occurs, but not to a large extent. There is a tendency that mothers, especially in rural areas, to report the age of a child whose actual age may be 10, 11 or 13, 14 months old as one year old. In general, however, such heaping does not pose any significant problem for the analysis of infant mortality. Whilst it is not possible to determine how many of the deaths heaped at 12 months

actually occurred before the child's first birthday and how many occurred after, evaluations of DHS data from other countries shows that the heaping at age 12 months does not significantly affect mortality estimates (Curtis, 1995: 38). Therefore, there is no need to redistribute the deaths to different ages as this would introduce an arbitrary element into the calculations from the assumptions used in the redistribution(Hill, 1991: 373). In addition, in a birth history the age of child and age at death are linked so that the effect of the age misreporting is not great. Age misreporting would bias mortality estimates by no more than five per cent (Sullivan et al., 1990). (as others have found).

Figure 3. 1. Age at death in month reported in the FBSS 1994, Lao PDR.



Source: Preliminary analysis of the FBSS, 1965-94, Lao PDR.

A similar problem for the estimation of child mortality is heaping at 60 months, but this is not likely to significantly affect child mortality estimates since the number of deaths reported at this age are not so large relative to those reported at 12months.

3. 3. 4. Data limitations

This analysis of infant and child mortality is limited by the absence of information on available economic and social resources. These variables have been shown to be important determinants of infant and child mortality . Among economic resources are family income, quality of housing which are associated with physical environment in which the family lives and amenities accessible to the family, while social resources range from characteristics of parents such as education, belief, religion to social and traditional norms (Ruzicka et al., 1989). Income is related to level of infant mortality, (Preston, 1975; UN, 1982).

Availability of toilet facility within household has been shown to be associated with lower infant and child mortality (Meegama, 1980; Trussell and Hammerslough, 1983; UN, 1985). Distance to different services, in particularly to hospital and dispensary is linked to levels of infant and child mortality (Al-Kabir, 1984). In a study of rural Nigerian villages in a more or less similar socio-economic context to the majority of least developed societies, it is found that health services have greater impact on populations in their immediate vicinity than on populations who stay farther away from locations where these health services are located due to difficulties and costs in transportation to health facilities (Orubuloye and Caldwell, 1975).

Unfortunately, the FBSS data set does not contain information on household income, availability of toilet, housing conditions or on access to services and health care. The discussion of the likely influences of these factors has to be inferred from other sources.

3. 4. Levels of infant and child mortality

Table 3.1. gives estimates of infant, child and under-five mortality rates, denoted by ${}_1q_0$, ${}_4q_1$ and ${}_5q_0$ for males and females and for both sexes combined. Data and

detailed estimation are presented in Annex A3. These probabilities refer to cohorts born between 1965-1994.

Table 3.1. Values of ${}_1q_0$, ${}_4q_1$ and ${}_5q_0$, 1965-94, FBSS 1994, Lao PDR.

	Infant mortality ${}_1q_0$	Child mortality ${}_4q_1$	Under-five mortality ${}_5q_0$
Males	0.1348	0.0700	0.1954
Females	0.1144	0.0703	0.1767
Total	0.1249	0.0701	0.1862
Gehan test statistic = 15.75; Degrees of freedom = 1; p = 0.0000			

Source: FBSS child file, 1965-94, Lao PDR, 1994, excerpt from *SPSS life table* procedure output.

It can be seen that the infant mortality rate (IMR) for both sexes combined is 125 per 1000 live births. The IMR for females is lower than for males, 114 deaths per 1000 live births against 135 deaths per 1000 live births. A similar differential is observed in other parts of the globe (UN, 1982; Ohadike, 1983; Lopez, 1983; Rutstein, 1983).

There is no difference in the child mortality rate between males and females, with a level of 70 deaths per 1000 children who survived to age one. As socio-economic conditions exert influences more on child mortality than on infant mortality (Hobcraft et al, 1984: 206), it may be that poor socio-economic conditions offset the better survival chance of female children during their infancy. Another study reveals that only one third out of 29 countries under study shows higher male than female mortality for the age group 1 to 4 years old (Rutstein, 1983: 23).

Table 3.1. also shows that almost a fifth of Lao children born die before reaching age five. The under-five mortality rate for both sexes is estimated to be 186 deaths per 1000 live births. The female advantage at age less than one year old is reflected in the probability of dying before age five: the female rate of 177 being

compared with the male rate of 195. This difference is very highly significant at 0.1 level of significance.

The estimates of infant and child mortality presented in Table 3.1. are quite consistent with estimates for cohorts born 15 years prior to 1993 published by the Maternal and Child Health Institute (MCHI). Using data from the 1993 Lao Social Indicator Survey (LSIS), the MCHI's estimates are 125 deaths per 1000 live births for IMR and 65 per 1000 for child mortality (MCHI, 1994). The LSIS is also a nationally representative survey using WFS type questionnaires for its demographic and health inquiry, and its sample is slightly smaller than the FBSS sample. The MCHI estimates were obtained by the same method of estimation as the present analysis, namely the life table approach. The infant and child mortality estimates of the present analysis are however higher than those estimated for the period 1989-94 by the Lao Women Union and the National Statistical Centre using data from the same survey, FBSS, which are an infant mortality rate of 113 per 1000 live births and a child mortality rate of 33 deaths per 1000 children surviving to age one (NSC/LWU, 1995). This discrepancy is most probably due to differences in methods of estimation and in the number of cases used in the analysis. Examination of data file used for the preparation of the FBSS report by the LWU/NSC reveals that the infant and child mortality rates were estimated by an indirect method based on the number of children ever born and the number of children surviving, though it is not clearly specified in the report exactly which method was used. Further, the number of cases used in the LWU/NSC analysis is only about one third of the cases used in this analysis. Although, its reference period is 15 years prior to the survey as in the case of LSIS analysis, the NSC/LWU analysis excluded children who were not reached their fifth birth day on the 9th of May 1994 for its child mortality estimate and infant who were not one year old for its infant mortality estimate, thus

sampling error is relatively larger and its also fails to capture mortality experience of children born in the most recent time and in the distant past.

Since the estimates obtained here cover the mortality experience of a larger number of cases and are compatible with the estimates obtained from LSIS data by the same method of estimation, they are believed to be more reliable than the LWU/NSC estimates.

3. 5. Estimated trends in infant and child mortality

Table 3.2. gives infant, child and under-five mortality rates by birth cohort, while the detailed life table is given in Annex A4. Figure 3.2. displays the trends in infant and child mortality, and $_5q_0$ over time for both sexes.

It can be seen that infant mortality has decreased over time. The decline in infant mortality prior to 1970 to 1970-74 is the largest, about 50 infant deaths per 1000 live births. Thereafter reduction in infant mortality occurs almost entirely during the period from 1975-79 to 1980-84, a reduction of 18 infant deaths per 1000 live births. The decline in infant mortality in 29 developing countries in North Africa, America and Asia covered by the World Fertility Survey during the 15-20 years prior to the early 1980s, on the average is 23 deaths per 1000 live births respectively (Rutstein, 1983: 35). From the period 1985-89 to the most recent period 1990-94, there is a slight increase in the estimates of infant mortality, 3 deaths per thousand live births. This increase may be the negative consequences of the demise of foreign aid from the former Eastern bloc countries and of the structural adjustments and privatization introduced by the government since 1986, including severe resource severance in providing free health care to the population. These structural adjustments, mainly liberalization of trade, prices and exchanges rates and privatization, also mean the cessation of food subsidies

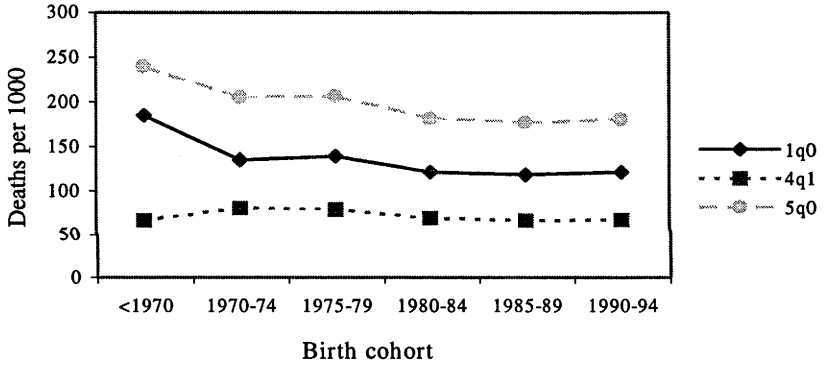
Table 3.2. Values of $_1q_0$, $_4q_1$ and $_5q_0$ for both sexes and Gehan test statistics of survival experience by birth cohort, 1965-94, FBSS 1994, Lao PDR.

Birth cohort	Infant mortality $_1q_0$	Child mortality $_4q_1$	Under-five mortality $_5q_0$
1990-94	0.1217	0.0672	0.1807
1985-89	0.1186	0.0666	0.1773
1980-84	0.1213	0.0691	0.1820
1975-79	0.1389	0.0788	0.2068
1970-74	0.1354	0.0810	0.2054
<1970	0.1851	0.0665	0.2393

Gehan test statistic= 117.575; Degrees of freedom = 5; p = 0.0000

Source: FBSS child file, 1965-94, Lao PDR, 1994, excerpt from *SPSS life table* procedure output.

Figure 3. 2. Infant, child and under-five mortality by birth cohort, FBSS 1994, Lao PDR



Source: FBSS child file, 1965-94, Lao PDR, 1994, excerpt from *SPSS life table* procedure output.

and increased prices of all basic commodities including health services and medicines which could have deleterious effects on the health and mortality of the population.

The slight increase for the period from 1970-74 to 1975-179 was most likely to be due to war, political turbulence and economic disorders which reached its height in the period 1970-74 leading to the downfall of the Royal government in 1975 and to economic crisis, precarious health conditions resulting from large population displacement and serious malnutrition among population, particularly children and the elderly resulting from severe droughts in 1978-79 causing serious food deficit in almost

all parts of the country. Prohibition of inter-province movement of food stuff imposed by the newly established government between 1975 to 1980 also contributed to the rise of infant mortality between these periods.

During the period 1970-74 to 1980-84, child mortality also displays a decreasing trend. The sluggish in the child mortality after 1985-89 is owing to the same explanation as the lack of progress in infant mortality during the same periods. From 1970-74 to 1985-89, child mortality decreased by 14 deaths per thousand live births. Child mortality during the period prior to 1970 is low compared with the next period is likely to be contributed to underestimation of age at death by which some of child deaths could have been reported as infant deaths.

The decline of infant and child mortality in Lao PDR mainly in the period 1975-79 to 1980-84 is likely be attributable to the improvements in political and socio-economic stability relative to the war period prior 1975, and also to the efforts of the newly established government to show people that the new founded socialist regime is better than the former decayed regime in caring for population by expanding education and health services, which is typical of a socialist government, for example Cuba and China (Caldwell, 1986) and which, relative to development in economic areas, is easier to carry out with huge amount of financial and technical assistance from eastern block countries. From 1976 to 1990, number of hospitals and dispensaries have more than doubled; the increase is even more striking in the number of dispensaries (NSC, 1995a: 162). Health care and some medicines, mostly antibiotics and vitamins used to be provided free of costs to the population. Since 1975 until early 1980s, illiteracy campaign has been launched vigorously and number formal education institutions has increased dramatically, and in fact education has been the only obvious area in which the new government has been successful (ShuiMeng, 1991). Overall, it seems that the

main improvements in mortality were made 1975-84 and only small improvements 80-84 to 85-89.

Other estimates of infant and child mortality for the period prior to 1970 support the above finding that infant and child mortality has actually declined, but the magnitude of the decline is not known with certainty. The Gehan test presented in Table 3.2. confirms that the decreasing trends in infant and child mortality rates are very highly significant. Breakey and Voulgaropoulos (1976), using data from the 1968-69 Lao Health Survey of the Mekong Valley (1968-69 LHSMV), report that infant mortality rate (IMR) for Laos was 150 deaths per 1000 live births (Breakey and Voulgaropoulos, 1976: 50). However, this infant mortality rate could not be taken as the national rate for Laos because, as pointed out in Chapter 1, the 1968-69 LHSMV covered only 15 villages along the fertile Mekong valley under the Royalist government and these villages were not directly affected by the war. Infant mortality in the zone occupied by the Pathet Lao would no doubt be much higher than these estimates, as this zone was directly involved in warfare and underwent daily bombardment and was deprived of all necessary maternal and child health care.

In addition, the observed trends in infant and child mortality confirm a view forwarded by other studies that only slight improvement occurred in infant and child mortality in Lao PDR during the 1980s and early 1990s (UNICEF, 1992; MCHI, 1994; LWU, 1995). This reflects the relative low level of social development, and the slow improvement in the general living conditions of the population. Social development in Lao PDR still lags behind economic development (World Bank, 1995b).

3. 6. Summary

Infant and child mortality remains high in Lao PDR. Few countries in the world experiencing the infant mortality rate exceeding 100 (US Census Bureau, 1994).

Except for the period from 1907-74 to 1975-79, infant mortality has also declined until 1985-89. The rise during the period from 1907-74 to 1975-79 was attributed to severe food shortage, economic crisis and political turbulence. Since the period 1970-74 to 1985-89 child mortality has also decreased. Infant and child mortality reduction achieved mainly during the period 1975-79 to 1985-89 was credited to improvements in nutrition, health care and education facilitated by more political and socio-economic stability relative to previous periods. The sluggish in infant and child mortality from the period 1985-89 to 1990-94 is likely the effects of the abrupt disruption in social services caused by the cease of aid flow from socialist countries, and the increase in food and medicine prices resulting from the International Monetary Fund imposed model of structural adjustment policy adopted by the government since the second half of the 1980s.

However, the pace of decrease in infant mortality in particular, has not been sufficient to achieve low infant mortality in Lao PDR, mainly due to its under-developed state of health care services and poor living standards of its population, since economic factors and levels of well being is extremely important in the transition from high to low value of infant mortality rate (Palloni, 1990: 190). Given the general priori that infant and child mortality are sensitive indicators of social and economic development (Arriaga and Hobbs, 1982; McDonald, 1982; Ruzicka and Kane, 1990), high level of infant and child mortality and little progress gained in child survival in Lao PDR would no doubt reflect the state of least development in the areas of social services necessary for reducing early childhood mortality and the lack of improvement in health care, nutrition and in the overall living standards of the general population.

Evidence from other parts of the world (Meegama, 1980; United Nations, 1982; United Nations, 1985; Arriaga and Hobbs, 1982; Rutstein, 1983; Hobcraft et al., 1984;

Ruzicka and Kane, 1987, 1990) seems to suggest that there are differences in infant and child mortality according to various socio-economic characteristics of the population. It is expected therefore that infant and child mortality in the Lao case would also display variations across different socio-economic variables. Differentials in child survival and the strength of the influences each socio-economic factor on the chances of infant and child survival are examined in Chapter 6.

Chapter 4

National life tables

4. 1. Data and method

It is commonly acknowledged that the life table is a powerful tool in mortality analysis. As age-specific deaths vary greatly from one age to another, one way of summarizing them independently of the population age structure is by means of life table statistics such as the life expectancy at birth or the probability of surviving from one exact age to another (Trussell and Hammerslough, 1983). To date, it has not been possible to directly construct life tables for Lao PDR because of the lack of reliable age-specific data on mortality. Life expectancies at birth of 48 to 50 years have been based on model life tables (D'Souza, 1993: 33; SSC, 1992: 26).

The analysis of the previous two chapters enables life tables to be constructed. With adult age-specific death rates and with the values of the probabilities of surviving from birth to exact age one and from age one to age four centring on the year 1990 obtained from the FBSS, abridged life tables for males and females are constructed and presented in this chapter.

As the FBSS do not adequately provide reliable estimates of mortality by single years, estimates for a ten-year cohort are used in order to have sufficient numbers exposed to the event of death. The estimates of the probabilities of dying from the FBSS refer to the mortality experience of the cohort born in 1985-1994, which has the central point at 1990. Adult age-specific mortality rates estimated in Chapter 2 also refer to 1990. Hence the life tables constructed in this chapter pertain to the mortality schedules of the year 1990.

Life table construction is based on probabilities of dying, q(x). The values of the probabilities of dying from birth to age one, ${}_1q_0$, are 0.1268 and 0.1129 for males and females respectively. The values of the probabilities of dying, from age one to four, ${}_4q_1$, are 0.0655 and 0.0682 for males and females respectively.

At adult ages, the age-specific death rates, m(x), obtained in Chapter 2, need to be converted to probabilities of dying, q(x). The values of ${}_nq_x$, are derived from adult age-specific death rates based on the following simple equation:

$${}_5q_x = (5 * {}_5M_x)/(1+2.5* {}_5M_x),$$

where ${}_5q_x$ is the probability of dying from exact age x to x+5, and ${}_5M_x$ is the age-specific death rate for the age interval x to x+5.

4. 2. Abridged life tables

The q(x) and l(x) values by sex are shown in Figure 4. 1. and Figure 4.2, respectively.

Figure 4. 1. Values of q(x) by sex plotted against a logarithm scale, Laos, 1990

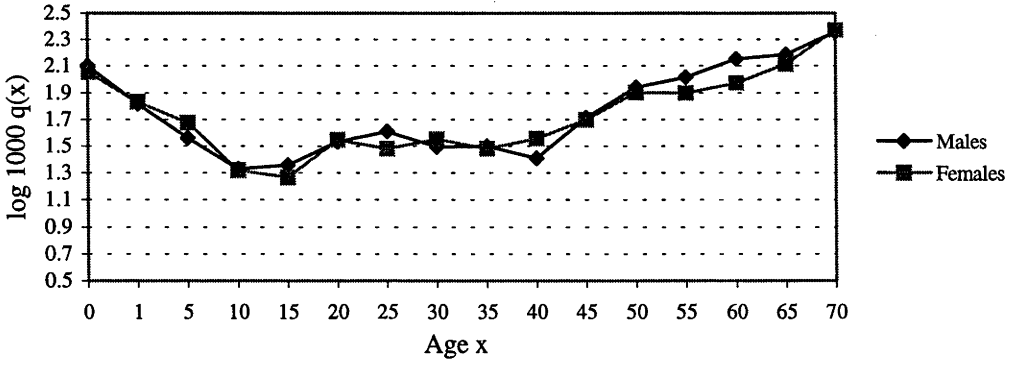
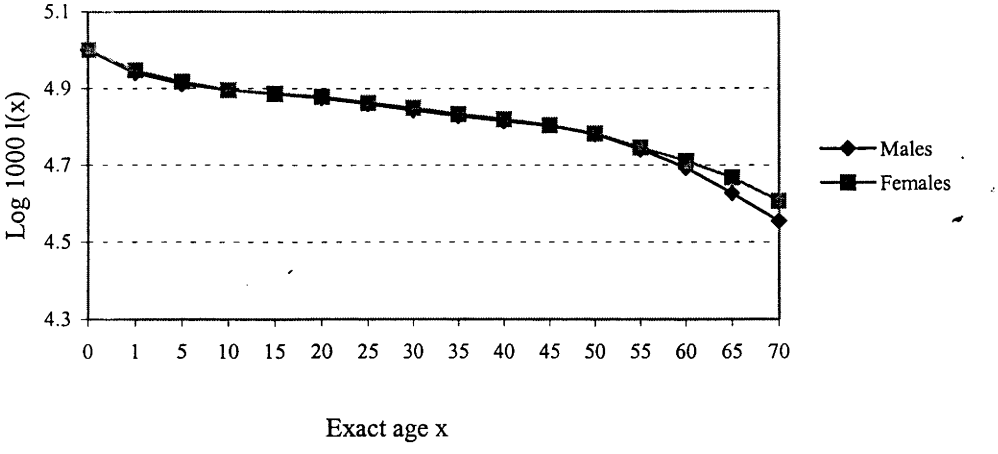


Figure 4. 2. Values of l(x) by sex, plotted against a logarithm scale, Lao PDR, 1990



Source: Table 4.1 and Table 4. 2 , computed from adult age-specific death rates obtained in Chapter 2 and infant and child mortality obtained in Chapter 3.

Tables 4. 1 and 4. 2 present abridged life tables for males and females for Lao PDR in 1990. The description of columns in the abridged life tables are given in Appendix A. 4.1. together with the formulae used for their computation.

Table 4. 1 : Abridged life table, males, Lao PDR, 1990

Age (x)	n	l_x	${}_nq_x$	${}_nd_x$	${}_np_x$	${}_nL_x$	T_x	e_x
0	1	100000	0.1268	12680	0.8732	90820	4886947	48.87
1	4	87320	0.0655	5719	0.9345	337270	4796127	54.93
5	5	81601	0.0366	2989	0.9634	400533	4458857	54.64
10	5	78612	0.0215	1688	0.9785	388840	4058324	51.62
15	5	76924	0.0227	1748	0.9773	380250	3669484	47.70
20	5	75176	0.0342	2569	0.9658	369458	3289234	43.75
25	5	72607	0.0407	2957	0.9593	355643	2919777	40.21
30	5	69650	0.0312	2171	0.9688	342823	2564134	36.81
35	5	67479	0.0315	2127	0.9685	332078	2221312	32.92
40	5	65352	0.0258	1684	0.9742	322550	1889234	28.91
45	5	63668	0.0519	3307	0.9481	310073	1566684	24.61
50	5	60361	0.0872	5261	0.9128	288653	1256612	20.82
55	5	55100	0.1035	5704	0.8965	261240	967959	17.57
60	5	49396	0.1422	7026	0.8578	229415	706719	14.31
65	5	42370	0.1533	6495	0.8467	195613	477304	11.27
70	5	35875	0.2290	8216	0.7710	158835	281692	7.85
75+	5	27659	1.0000	27659	0.0000	122857	122857	4.44

Table 4. 2 : Abridged life table, females, Lao PDR, 1990

Age (x)	n	l_x	$_nq_x$	$_nd_x$	$_np_x$	$_nL_x$	T_x	e_x
0	1	100000	0.1129	11290	0.8871	91826	4998520	49.99
1	4	88710	0.0682	6050	0.9318	342135	4906694	55.31
5	5	82660	0.0476	3934	0.9524	403465	4564559	55.22
10	5	78726	0.0208	1639	0.9792	389533	4161094	52.86
15	5	77087	0.0186	1435	0.9814	381848	3771562	48.93
20	5	75652	0.0352	2663	0.9648	371603	3389714	44.81
25	5	72989	0.0303	2210	0.9697	359420	3018112	41.35
30	5	70779	0.0356	2522	0.9644	347590	2658692	37.56
35	5	68257	0.0301	2057	0.9699	336143	2311102	33.86
40	5	66200	0.0361	2389	0.9639	325028	1974959	29.83
45	5	63811	0.0498	3177	0.9502	311113	1649932	25.86
50	5	60634	0.0802	4864	0.9198	291010	1338819	22.08
55	5	55770	0.0791	4413	0.9209	267818	1047809	18.79
60	5	51357	0.0939	4821	0.9061	244733	779992	15.19
65	5	46536	0.1301	6054	0.8699	217545	535259	11.50
70	5	40482	0.2350	9512	0.7650	178630	317714	7.85
75+	5	30970	1.0000	30970	0.0000	139084	139084	4.49

It can be seen that the life expectancy at birth, e(0), is 48.9 and 50.0 years for males and females respectively. The sex differential of 1.1 years might be regarded as rather small, since the West model life tables embody a difference of 2.89 years at this mortality level. The above life tables are the first life tables for Lao PDR built from empirical data, and their accuracy is dependent on the accuracy of those data. Assuming a sex ratio at birth of 105, e(0) for both sexes combined would be 49.4 years. Using as a rough yardstick e(0) for Lao PDR put forward by Ruzicka and Hansluwska (1982: 88), which was 40 to 44 years in around 1975, it can be said that the gain in longevity in the last 20 years or so for Lao people has been modest. Low life expectancy can be said to be an undeniable feature of the social and economic conditions of Lao PDR.

To gain knowledge of at what level Lao mortality is in reference to model life tables, Lao mortality was matched with the Princeton model life tables (Coale and Demeny, 1983), and West mortality pattern was found to be most appropriate. The mortality schedules for Lao PDR are compared with Level 13 of the West model life

tables in Figures 4.3 and 4.4 for males and females respectively. Level 13 of the Princeton West model life tables was chosen on the grounds that the infant and child mortality estimates for both males and females provided by the FBSS are quite close to the values of ${}_1q_0$ and ${}_4q_1$ in West level 13 . Furthermore, in the analysis of the original MVSS data, it was found that the population distribution of the MVSS for males and females is closely matched by the stable population of the West model level 13 (D'Souza, 1993: 32). It can be seen from Figures 4. 3. and 4. 4. that the mortality schedules for Lao PDR obtained from the MVSS and FBSS data for males and females follow similar pattern of deviation from the model life tables.

To give a better view of the differences in mortality schedules between Lao PDR and neighbouring countries, particularly Thailand which has a similar ethnic, cultural and religious background and home to twenty million Lao people, Figures 4. 3. and 4. 4. provide probabilities of dying for Lao PDR and its two neighbouring countries, Thailand and Malaysia, for males and females.

Compared with Thailand and Malaysia, Lao PDR clearly has much higher mortality. The different is greatest in childhood and young adult ages, but convergence starts to take place from about age 30 for both males and females. The difference in child mortality is greater than in infant mortality. Given that the levels of socio-economic development in Thailand and Malaysia are much higher than in Lao PDR, the larger difference found in child mortality confirms the view of stronger influences of socio-econmic factors during childhood than in infancy.

Figure 4. 3. Values of q(x) for Lao PDR, Thailand, Malaysia and a West model life table level 13, males.

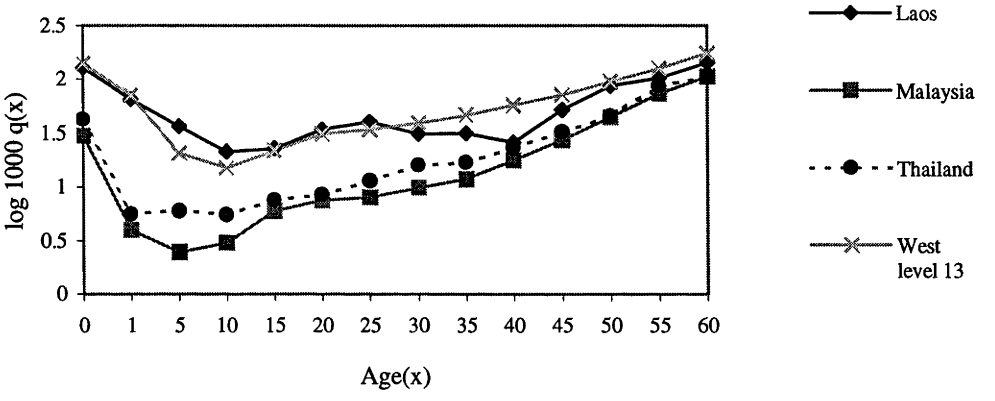
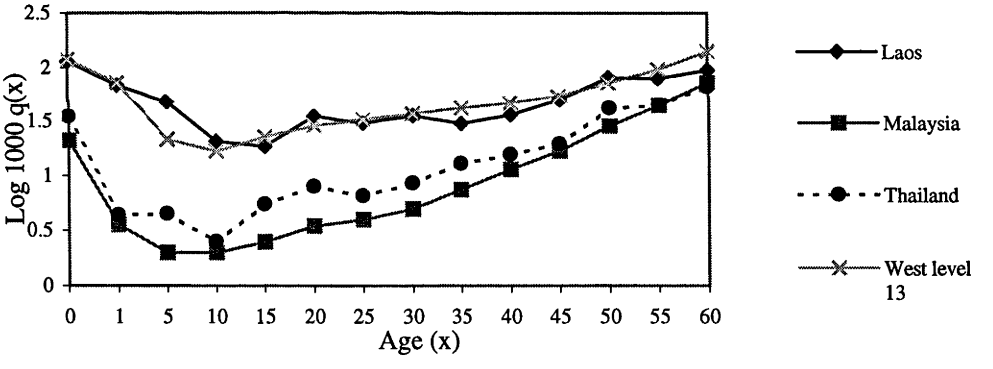


Figure 4.4 Values of q(x) for Lao PDR, Thailand, Malaysia and a West model life table level 13, females.



Source: Data for Lao PDR are derived from the tabulation of the MVSS data set and infant and child mortality from FBSS data; q(x) values for Thailand and Malaysia are computed from data contained in the 1992 Demographic Yearbook, United Nations 1994, page 642.

The sharper contrast observed in females is not unexpected, since mortality in Thailand and Malaysia is at quite a low level. As mortality declines the gap in sex differentials of mortality widens (United Nations, 1982; 1988). Meanwhile, the sex gap in

mortality in Lao PDR is still narrow; mortality in Lao PDR may have just started on its journey toward transition.

The patterns of adult mortality in Lao PDR, are less regular than those found in the other countries. In addition to reasons provided in Chapter 2 for high mortality among young adults and sampling fluctuations at older ages, another possible explanation for this kind of mortality pattern can be drawn from the cohort analysis of a European population, for which similar disturbances in adult mortality are attributed to the negative influences of unfavourable living conditions in the early period of life, whereby high mortality at early ages is linked to high mortality up to age 45, but not at later ages (Caselli and Capocaccia, 1989: 144). Caselli and Capocaccia argue that if living conditions in early life are unfavourable, negative effects can continue until age 45 years as the same conditions that cause high mortality at early ages produce greater vulnerability in the survivors until their 45th birthday. High adult mortality in Lao PDR may owe much to the prevalence of accidents, hazardous working environments and high maternal mortality, and from the effects of harsh and unfavourable conditions at early ages which continue to make these survivors vulnerable to disease and death. The convergence of the Lao mortality schedules with those of Thailand and Malaysia toward old ages, as seen in Figures 4. 3. and 4. 4., seems to substantiate this argument.

In discussing the disparity in mortality between Lao PDR and Thailand, it would be more interesting to look at the level of mortality of Lao people living in the Northeastern region of Thailand. In the 1960s and early 1970s the levels of socio-economic development in the Northeastern region of Thailand and nutritional status of its population were not much better than those found in Laos (Sisouphanthong, 1995). Compared with the Northeastern region of Thailand, where development lags behind other regions of Thailand (THAI_NSO/OPM, 1991), the infant mortality level in Lao

PDR is found to be about three times higher. The infant mortality rate for the Northeastern region of Thailand for 1991 is only 42 deaths per 1000 live births, though this region's mortality is the second highest after the Northern Thailand (THAI_NSO/OPM, 1991: 46). However, problems of socio-economic development, nutrition and health in Lao PDR since the 1970s have been much worse than in the Northeastern region of Thailand (Sisouphanthong, 1995). The health problems in a number of Asian countries with high mortality levels are associated with the state of underdevelopment itself, widespread poverty, lack of education, poor sanitary and health conditions, and inadequate diet (UN, 1982: 119).

4. 3. Conclusion

To date, the lack of reliable age-specific mortality data has impeded the construction of life tables directly from survey data. The MVSS provides a good source of information on adult age-specific mortality rates, and reliable infant and child mortality data are obtained through the FBSS, which allows for the first time the construction of life tables directly from survey data. Low values of life expectancy at birth of 48.9 for males and 50.1 for females place Lao PDR among the high-mortality countries and certainly reflect its backwardness in social development.

The life table estimates obtained can be said to depict the true mortality situation of the Lao people. Unfortunately data do not adequately allow the construction of life tables by different characteristics of the population subgroups. Analysis of mortality differentials for the adult population, presented in the chapter 5, and for infants and children in Chapters 6 and 7 will nevertheless aid the understanding of determinants of mortality in a context where there is a lack not only of socio-economic development but also socio-economic and demographic data.

Chapter 5

Differentials in adult mortality

5. 1. Introduction

In general, mortality in human populations is influenced by the interrelation of biological, socio-economic, and environmental factors. Regardless of the level of the mortality, pronounced mortality differentials prevail among various groups within each country (Ruzicka and Kane, 1990: 21). As mentioned in Chapter 1, Lao PDR varies in its topography and is inhabited by a diversity of people belonging to different tribes and major ethnic groups who carry out different types of livelihood depending on the geographical locations of their settlements. As a result of the contextual differences prevailing in different ecological zones, Lao PDR also experiences an uneven distribution of wealth and development, with marked differences in living conditions and other socio-economic indicators. Such variation is believed to be manifested in the differentials found in a number of demographic parameters like fertility and mortality, as well as contraceptive prevalence rate and utilization of health care (Foley and Vongsak, 1991; Phimmasone et al., 1994; MCHI, 1994; NSC/LWU, 1995).

This chapter examines differentials in adult mortality according to geographical region, agro-ecological system, place of residence and ethnicity. Various studies show that the factors associated with levels of mortality include urban-rural residence, social class, occupation, level of income and nutrition. Urban-rural differentials have been well documented (Ruzicka and Hansluwka, 1982: 85). Urban-rural mortality differentials are encountered in all parts of the developing world, although in a few countries in Latin America the urban-rural infant and child mortality differentials are diminished when

parental education is controlled (UN, 1982). Caldwell (1979) also shows that in a Nigerian setting, urban-rural mortality differentials become minimal when mother's education is taken into account.

It is found in the African context (Caldwell and Caldwell 1991; Defo, 1993; Mammo, 1993) and in the Asian context that ethnicity is important in determining mortality, especially infant and child mortality (UN, 1982; Peng and Abu Bakar, 1986). Geographic, religious and ethnic divisions are often found to be intertwined, and sometimes very difficult to separate, because of the way data have been collected or because of the ways that ethnic and religious groups are distributed geographically (UN, 1982: 106). Nevertheless, Ohadike (1983) points out that among other biological determinants such as ethnicity and race, age and sex remain the most frequently used indicators of the chance of dying, since age and sex have particular implications for the determination of the level and pattern of death rates (Ohadike, 1983: 34). Age patterns of mortality by sex are analysed in this chapter for different population sub-groups to determine mortality between subgroups. It is however acknowledged that there is overlap between the variables used to define these subgroups.

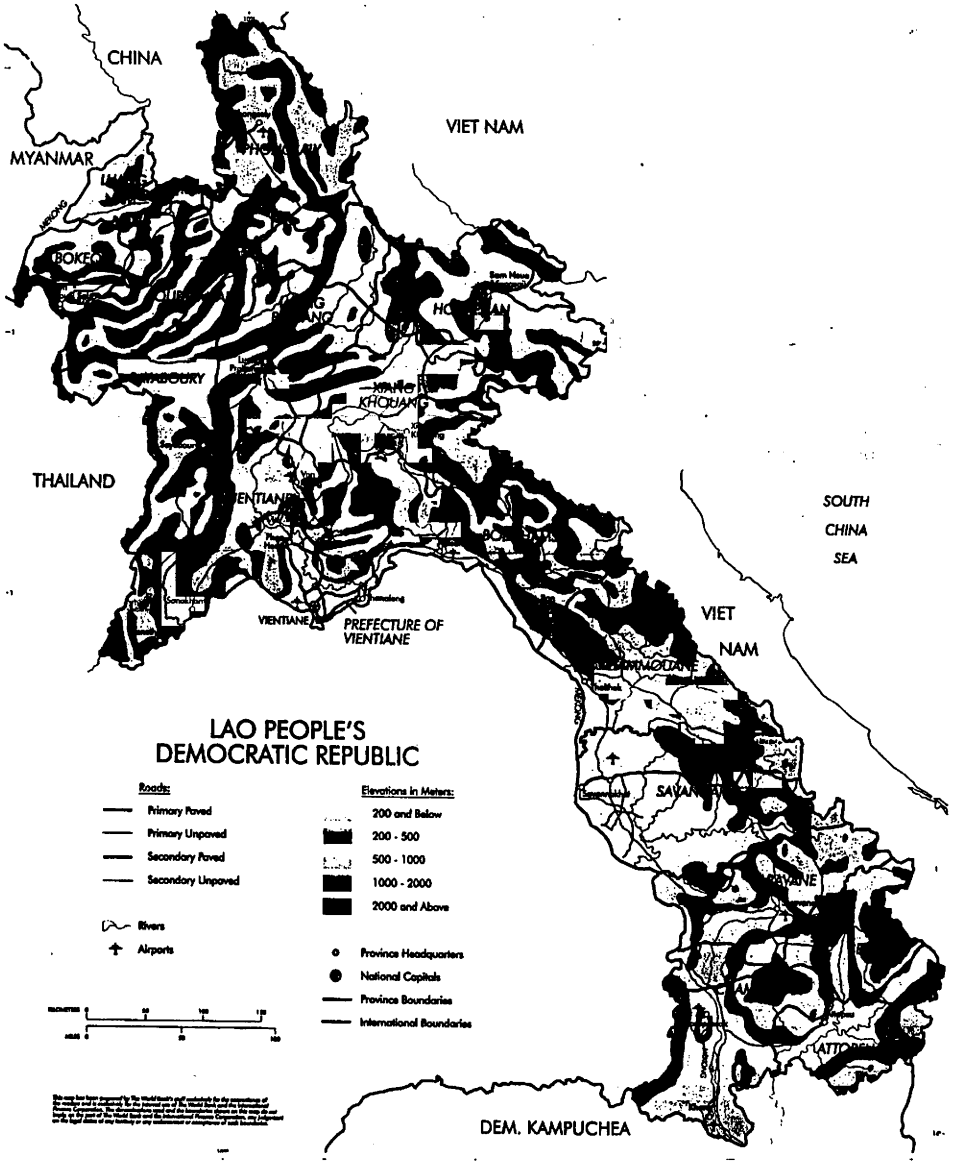
5. 2. Classifications of variables used for the analysis of mortality differentials

5. 2. 1. Agro-ecological classification

Typically Laos is divided into four distinctive agro-ecological zones, namely high-mountain, low-mountain, plateau and plain. The high-mountain zone includes mountains above 1000 metres occupying around 30 per cent of the total area of the country, mostly concentrated in the north and east. The low mountain zone with lower altitude occupies some 35 per cent of the total area of the country. Plateau with an altitude ranging from 500 to 1000 metres covers about 15 per cent of country. Only 20 per cent of the

country's terrain is Lowland plain (Sisaliao et al., 1989:31). A topographic map of Lao PDR is given in Figure 5. 1.

Figure 5.1. Topographic map of Lao PDR



Source: Lao People's Democratic Republic: Country Economic Memorandum, Report No. 12554-LA, World Bank, 1995.

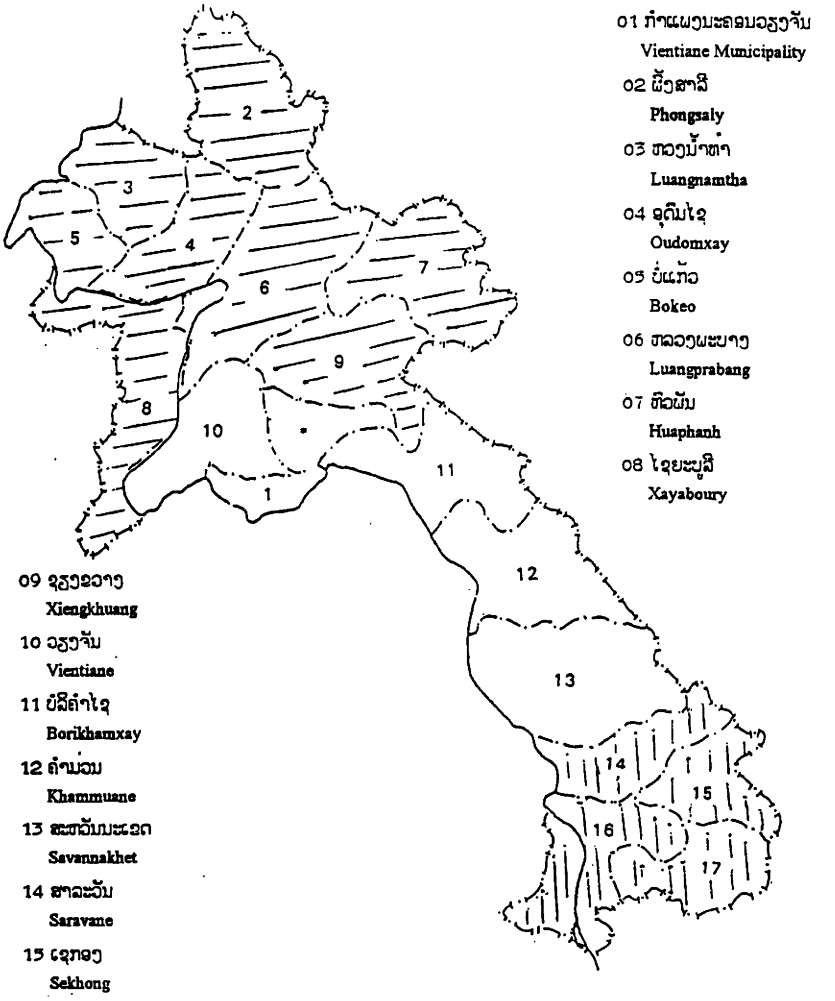
Despite the fact that the MVSS survey makes no provision for the classification of population by agro-ecological zone, such classification was considered useful for the examination of mortality differentials. Classification was carried out by locating sampled villages on an agro-ecological map.

In order to have a sufficiently large number of cases, high and low mountains and plateau were combined into one agro-ecological zone, namely Highland. This is because first the sample size for plateau is too small, only 13.5 per cent, resulting in too small a number of cases when data are examined by sex and age group, and secondly the predominant mode of agricultural production in both the plateau and mountainous areas is slash-and-burn cultivation and to some extent both the areas are located at high altitude and experience more-or-less similar degrees of development. The sample sizes for Lowland and Highland zones are 56,393 persons (57.5 per cent) and 41,640 persons (42.5 per cent) respectively.

5. 2. 2. Regional classification

For the analytical purposes of the thesis, the country is divided into three geographical regions: the north, the centre and the south. This classification conforms to the official practice in regional classification for socio-economic development planning purposes. Figure 5. 2. gives a map of regions and their provinces covered in the MVSS. The overlap of the regional classification with that of the agro-ecological zone can be seen from this map, in which the majority of the north is mountainous whereas the majority of Lowland plain is in the centre and the south. The northeastern part of the centre and the east of the south are also mountainous areas. A huge plateau, Boloven Plateau, is situated right in the centre of the south.

Figure 5. 2. Map of provinces and regions of Lao PDR covered by the MVSS



Source: Adapted from a map contained in 'Basic statistics about socio-economic development in the Lao PDR, National Statistical Centre, 1995.

The north comprises eight provinces: Phongsaly, Luangnamtha, Oudomsay, Bokeo, Luangphrabang, Huaphan, Xayaburi and Xiengkhuang. The sample size for the north is 34,716 persons (35.4 per cent of the total sample). The centre consists of Vientiane Municipality, Vientiane province, Borikhamxay, Khammuan and Savannakhet. The sample size for the centre is 39,599 persons (40.4 per cent). The sample size for the south is 23,720 persons (24.2 per cent). The south covers four provinces: Saravane, Sekong, Champasack and Attopeu.

5. 2. 3. Urban-rural place of residence

In the MVSS survey, an urban village is defined as satisfying at least three of the following criteria: (1) the presence of a market in the village; (2) road access to the village which is passable by motor vehicles; (3) the provincial or district administration is located in the village; (4) the majority of households are electrified; and (5) most households have access to piped water supply. Any village that does not satisfy at least three of these criteria is classified as a rural village.

Apart from villages in the municipalities of the provinces, most urban villages in the MVSS only satisfy the first three criteria. The sample size of the urban area is 23,201 persons or 23.7 per cent, while that for the rural area is 74,835 persons or 76.3 per cent.

5. 2. 4. Ethnic classification

The Lao population is usually classified into three major ethnic groups. These are the Laoloum (Lowland Lao or broadly classified as Lao-Tai groups) who make up about 60 per cent of the total population of the country; the Laotheung (the Mon-Kmer groups) who account for slightly above 25 per cent of the total population; and the Laosoung (the Miao-Yao and Sino-Tibetian groups) and other minorities sharing about 10 per cent and 5 per cent respectively of the total population (Sisaliao et al, 1989). This ethnic composition should be viewed as a rough guide only since the exact ethnic

composition of the Lao population was not know with certainty; the 1985 census recorded 800 self-identified tribes, and for many the exact affiliation in the three major ethnic groups was not known (SSC, 1992).

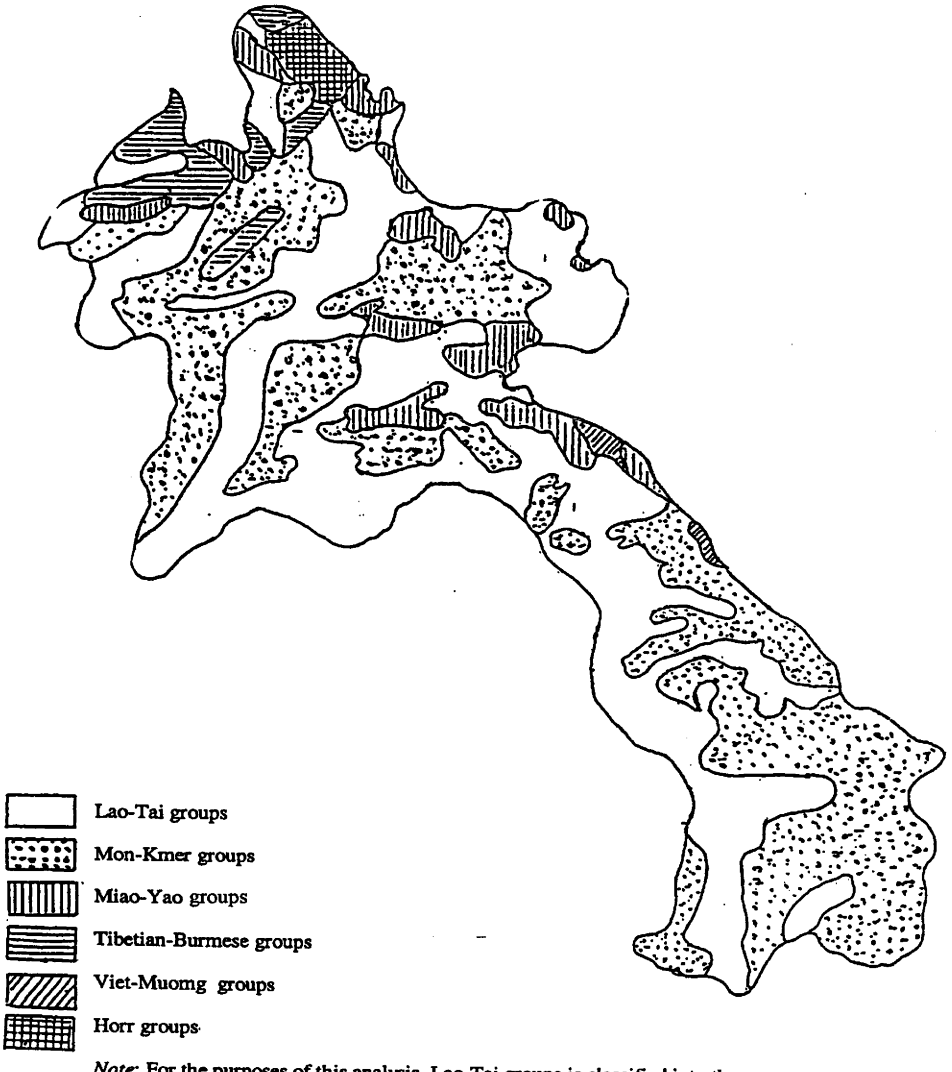
Figure 5. 3. presents a map of areas predominantly inhabited by different ethnic groups. It is not a definite demarcation in itself as cohabitation exists in some cases, particularly in cities or among the non-agrarian population, between some tribes of Laotheung and Laoloum, and to a much lesser extent between Laosoung and others. This map clearly shows that the Laoloum mainly live on the alluvial Lowland plains along the Mekong river.

In order to have a sufficiently large number of cases for the study of mortality by ethnic group, as far as the data set would permit a sound analysis, the population is classified into two major ethnic groups: Laoloum and other ethnic Lao (referred to as 'Other Lao'). The grouping of Laotheung and Laosoung together is based on the fact that these people are predominantly hill and mountain dwellers and live by shifting cultivation. They also possess similar types of livelihood, belief, traditional values and customs in relation to health and morbidity and their causes. The sample includes 77,124 persons (78.7 per cent) belonging to Laoloum, while the Other Lao constitute the rest of the sample (20,913 persons or 21.3 per cent).

5. 3. Adult mortality differentials

The discussion of age-patterns of mortality differentials is divided into two parts: from age 5 to 39 and from 40 and over. This is due to differences in patterns of mortality differentials between these two age segments. Age-specific death rates are shown in Figure 5.4. to 5.7. on log scale. The number of population, number of deaths and actual age-specific death rates, ${}_nM_x$, which are the sources of these figures, are given in the Appendix , Tables A 5.1. to A.5.8.

Figure 5. 3. Geographical distribution of Lao population by ethno-linguistic affiliations



Note: For the purposes of this analysis, Lao-Tai groups is classified into the category 'Laoloum', and the rest is classified as 'Other Lao'.

Source: ' The population of Lao PDR', State Statistical Centre, State Planning Committee, 1992.

It should be noted that differentials on the log scale are ratios, and if the rate for one subgroup is twice the rate for the other, the same differential will appear on the log scale no matter what the rates are. For example, if the age-specific death rate is 10 for the Lowland zone and 20 for the Highland zone at age group 15-19, and it is 5 for the Lowland zone and 10 for the Highland zone at age group 20-24, differentials at these two age groups are the same on the log scale because the ratio of the rate for the Highland zone to the rate for the Lowland zone is the same at both the age groups.

5. 3. 1. Differentials by agro-ecological zone

The significance of the agro-ecological classification for the study of mortality differentials lies in the fact that different agro-ecological zones denote different types of livelihood and different agricultural systems. In addition each agro-ecological zone is closely linked to the availability of transport and access to services such as health care, safe drinking water and other amenities. There are different climatic and disease environmental conditions between the two agro-ecological zones (UNICEF, 1992). Unfavourable environmental factors, such as climatic conditions, air and water pollution or the presence of disease vectors increase the risk of illness (Ruzicka and Kane, 1990:21). Figures 5.4.a. and 5.4.b display age-specific deaths rates for males and females respectively in the Lowland and Highland zones.

For the age range 5-9 to 35-39 years, males in the Lowland zone evidently have an advantage of mortality over their Highland counterparts. Mortality differentials between Lowland and Highland zones are clearly seen up to the age group 20-24. The large differentials at ages 10 to 19 is due to the fact that mortality gradient is very slight at ages 5 to 19 in the Highland zone. The differences in the ${}_nM_x$ values for males between the two agro-ecological zones are striking during young and some old ages, but apparently not so in the age groups 25-29 and 30-34. The Lowland zone has increasing

Figure 5.4.a. Adult age-specific death rates by agro-ecological zone, males, 1990

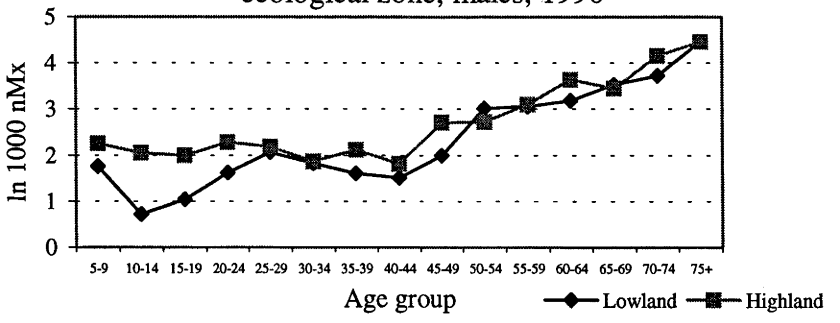
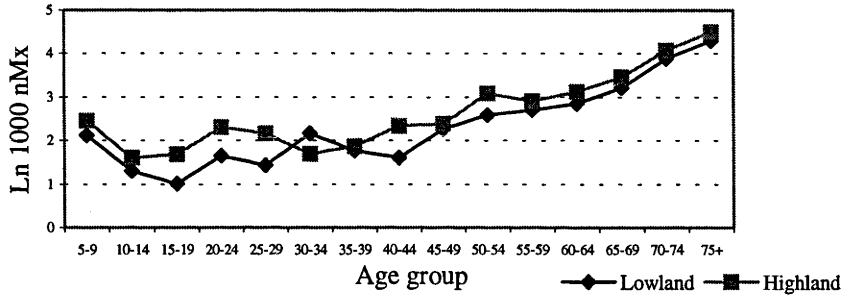


Figure 5.4.b. Adult age-specific death rates by agro-ecological zone, females, 1990



mortality at ages 20 to 34 whereas the Highland zone does not. This is likely to result from the fact that in addition to mortality from hazardous working environment, motor-vehicle and work related accidents are also responsible for this rise in mortality among young males in the Lowland zone. Motor-vehicle and work-related accidents are rare in the Highland zone as there are few roads and motor-vehicles and as the main occupation of people in the Highland zone is slash-and-burn cultivation and hunting and gathering of forest products which does not expose them to the kinds of accidents experienced in different industries in the Lowland zone. The similar levels of mortality observed at ages 25 to 34 may be, as discussed in Chapter 2, because these males are hard labour in the fields involving staying away from home during the production season such that the degree of mortality risk from work-related environment hazards in both zones could be

similar. At ages 40 and over, the differential in male mortality between the two zone is less clear, because of fluctuation arising from sampling error.

For females, there are clear differentials in the age-pattern of mortality between the two agro-ecological zones at both ages below 40, and 40 and over, except at the age group 30-34. Females in the Lowland zone clearly experience lower mortality than females in the Highland zone. At the age group 30-34, the lower level of mortality for females in the Highland zone is most probably due to sampling fluctuation.

Females in the Highland zone have markedly higher mortality at ages 20 to 29 than Lowland females. Higher mortality during the reproductive ages among females on the Highland zone suggests the effects of the lack of antenatal and postnatal care and home deliver, inadequate diet and frequent and closely spaced childbearing on maternal mortality.

The adult age-specific death rates indicate that people of both sexes in the Lowland zone generally experience significantly lower mortality than those living in the Highland zone. The mortality differentials between these two zones can also be attributed to the differences between permanent types of farming in the Lowland zone and shifting cultivation in the Highland zone. It is most likely that even more important factors influencing higher mortality levels in the Highland zone are the scarcity of medical services, safe water supply, education and other public services and in particular the almost complete absence of transport and communication networks in the high-altitude areas.

In a study in Guatemala, it was found that altitude is related to growth of children, and that this relation is attributable to land scarcity, poor agricultural conditions, and longer distance to transport and public service networks in the areas with altitudes of more than 1500 metres (Pebley and Goldman, 1995). Another study in Peru

suggests that higher infant and child mortality at high altitudes is the direct effects of high altitudes; high mortality persists even when family socio-economic status and health facilities are controlled for (Edmonston and Andes, 1983: 88). Because of the limited variables in the data set, it is not possible to examine the relative importance of such factors for mortality differentials between these two agro-ecological zones in Lao PDR, where these factors are undoubtedly operating.

In most of the Highland zone, only slash and burn cultivation of rice and plantation of perennial crops are feasible. The lack of appropriate land for permanent farming and the poor agricultural conditions in the Highland zone mean that the majority of the Highland people rely on the rotational slash-and- burn cultivation and foraging of forest products for their living. This is a factor contributing to poorer nutrition and health. It is found that most of those relying on slash and burn cultivation can rarely be self sufficient in food production (World Bank, 1995a; Lao PDR, 1996). Scarcity of food is severe in the Highland zone where, more so than in other parts of the country, droughts occur annually(Amalathithada et al., 1995).

This does not mean that the Lowland zone does not experience food shortage. In fact, it does, but not every year and the problem is not so severe as in the Highland zone largely owing to its better roads and transport, and marketing networks. Although, the plains and valleys along Mekong River and its tributaries are usually flooded every two years or so, production is not usually totally ruined and supplementary or second crops are always feasible (NSC, 1995a; Lao PDR, 1996).

Other factors contributing to the difference in the mortality levels observed are poor living and poor housing conditions, and a lack of sanitation and knowledge about modern health care and the importance of hygienic practices among people living in the Highland zone. Housing conditions are associated with disease and mortality (Kent,

1991; Burnett, 1991: 176). Housing conditions among people living in the high altitude areas are also inferior to those found in the Lowland areas and are usually crowded with very little ventilation (Kunstadter and Kunstadter, 1990). While water-borne diseases such as malaria and dengue fever are severe health problems in the Lowland zone, respiratory tract infection diseases such pneumonia and tuberculosis are more prevalent in the Highland areas (UNICEF, 1992, 1996). Indoor cooking and stove smoke contribute to high adult mortality in developing countries (Mosley and Gray, 1993).

It is observed that no schools and health posts exist at the high altitude areas where there is no road network. About 27 per cent of Highland villages do not have primary schools (UNICEF, 1996). A number of dispensaries are found in the relative lower altitudes of the Highland areas but they are often inoperative and unattended by qualified health workers (ANUTECH, 1996).

Because of the topographic characteristics of the Highland zone, dominated by rough mountainous terrain making transport horrendously difficult, the most serious hindrance to the distribution of goods and services and to the provision and accessibility of health care services is the very poor state of transport and road networks in the Highland zone. During the rainy season most of the rural mountainous areas cannot be reached by road (NSC, 1995b; UNICEF, 1992; 1996). This not only impedes the provision of health and educational services but also discourages people from using these services from distant places when they are available..

5. 3. 2. Differentials by region

There are regional differentials in mortality within many countries of the world (UN, 1982). Figures 5.5.a. and 5.5.b. exhibit the male and female adult age-specific death rates ($_nM_x$) for the three regions of Lao PDR: north, centre and south.

Figure 5.5.a. Adult age-specific death rates by region, males, 1990

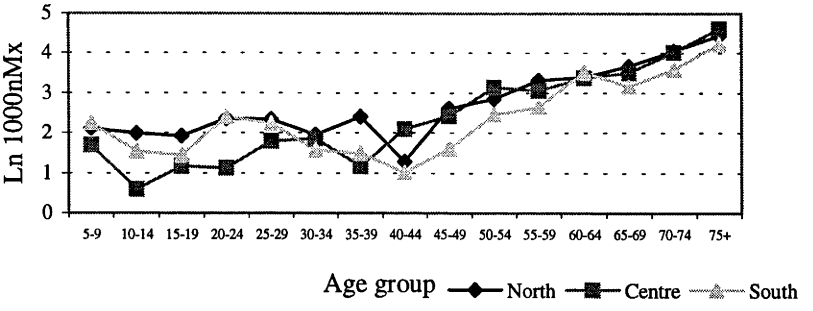
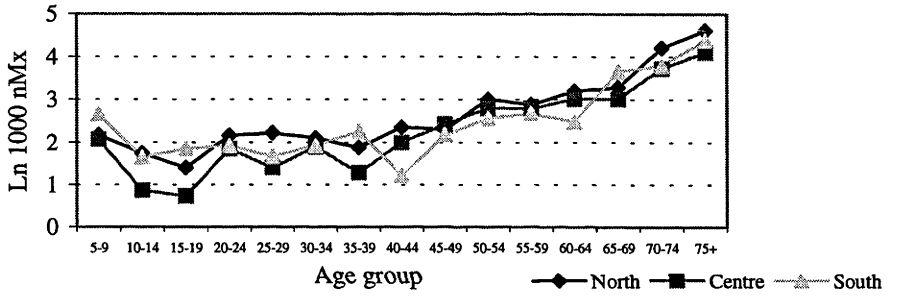


Figure 5.5.b. Adult age-specific death rates by region, females, 1990



For males, at ages 5 to 39 the levels of ${}_nM_x$ are generally the lowest in the centre and highest in the north. At age 5-9 mortality in the south is highest, probably because malaria which mostly affects children (Phanlavong, 1995) is more prevalent in the south than in the north (UNICEF, 1992). Differentials in mortality over the age range 5 to 29 observed between the north and the centre are similar to those found between Lowland and Highland zones. This clearly reflects the overlap between the north and Highland zones, because most of the terrain in the north is high and low mountains, with a relatively small proportion of Lowland. Consequently, the north suffers the same socio-economic disadvantages as the Highland zone.

Relative to the centre, the high mortality for the north and the south for the age groups 20-24 and 25-29, also found in the national age pattern of mortality for males, are undoubtedly attributable to relatively hazardous environmental and occupational conditions, particularly exposure to malaria and accidents and general lack of health services in the north and south, and worse nutritional intakes in the north. The increased mortality at ages 25-29 and 30-34 in the centre, approaching that of the other two regions, reflects also the presence of high occupational accidents, exposure to malarial diseases and poor nutritional status among these young men in the centre, especially in Savannakhet and the Highland areas of the eastern parts of other provinces of the centre. The slightly higher level of ${}_nM_x$ at age group 15-19 relative to the age group 20-24 in the centre is likely to result from motor accidents and other violent deaths among teenagers. Most of the important urban towns which have significant number of motor vehicles are located in the centre.

At ages 40 and over, the levels of ${}_nM_x$ for the north and the centre are roughly similar. The levels of ${}_nM_x$ for males aged 40 and over in the south are observed to be lower than those for males in both the centre and the north, except for the age group 60-64 where it is the highest, probably because of sampling error. Lower mortality for males aged 40 and over in the south than in the north and centre is likely to be attributable to better nutritional status among these people in the south. Nutrition is an important factor in resisting malaria episodes. Improvement in nutrition also increases host body resistance to diseases (McKeown et. al, 1975).

For females, at ages 5-39, mortality for the centre is the lowest, as found for males. A slight departure from this observation is at age groups 20-24 and 30-34 where ${}_nM_x$ levels in the centre approximate those in the south, perhaps because of age

misreporting. As in the case of males, high female mortality at ages 5-9 in the south is most likely due to malaria.

At ages 40 and over, however, a clear mortality disadvantage for females at most age groups in the north becomes obvious. Mortality at ages 40-64 among females in the south is even lower than that for females in the centre. Lower mortality at ages 40 and over is due to the same reasons as for males aged 40 and over.

It can be seen that at ages less than 40, mortality levels for males and females in the centre, particularly for males, are lower than the levels observed in the north and the south. At ages 40 and over, mortality levels for males and females in the south are lower than in the north and the centre. The age patterns of mortality for females in the north also display almost the same shape as that found among Highland females. The slight deviation observed in the age patterns of mortality for both males and females in the north from those found in the Highland is due to the fact some areas of the north are also Lowland plains.

The advantage of the centre in terms of mortality among the population below 40 years of age is due to better access to health care, sanitation and safe water supply, and other social services and the fact that consumer goods are more available than in the rest of the country. The transport network and road infrastructure in the centre are relatively good and serve a large proportion of the population. The extremely poor transport and road infrastructure of the north economically isolate it from the rest of the country. Conditions in the south are no better than in the north. In these two regions the percentages of villages to which there is no all-season road access are respectively 51 and 54 per cent for the north and the south (World Bank, 1995b). Such difficulty in transport conditions translates not only into difficulties in delivery of health programs such as

immunization, safe drinking water, supplies and personnel, but also into the people's reluctance to seek health care at the time of illness.

In the centre, economic development occurs at a faster pace than in the rest of the country. In 1992, the levels of per capita gross national product were US $161 for the north, US $ 262 for the centre and US $233 for the south. Evidence from India and from many other countries suggests that mortality declines with higher income, and many other factors, not all of which are themselves strongly correlated with income, also have a strong influence on demographic outcomes (Preston, 1975; Gwatkin, 1980; Murthi et al., 1995).

Differentials in food availability are also observed between the three regions. Nutritional status is said to be strongly correlated with mortality levels (Ruzicka, 1990; Scholfield, 1991), and it is suggested that improvement in nutrition had played a central role in the reduction in mortality in England and Wales during the first half of the twentieth century (McKeown et al., 1975). In this respect, the centre and the south are in a better position than the north. The centre is the leading region in terms of per capita rice production, followed by the south. Animal production of all kinds per capita is more evenly distributed across the three regions of the country (NSC, 1995a). Fish is more abundant in the south and the centre.

5. 3. 3. Differentials by urban or rural residence

Differential mortality by place of residence is a proxy for the inequality in the distribution of wealth and development (Hobcraft et al., 1984). As in other developing countries, urban and rural areas of Lao PDR experience different levels of socio-economic, physical and institutional development. Since the majority of the Lao population lives in the rural area, the age pattern of mortality for the rural population is very similar to that observed for the national population. The urban population

constitutes only 24 per cent of the total population which means that sampling fluctuation is relatively large especially at older ages. Figures 5.6.a and 5.6.b present the age-specific death rates, for males and females respectively.

Figure 5.6.a. Adult age-specific death rates by place of residence, males, 1990

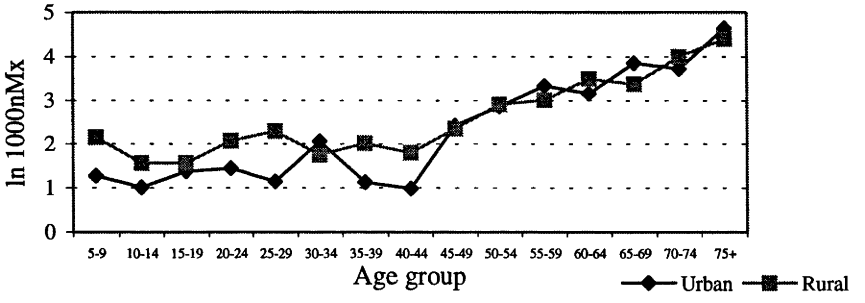
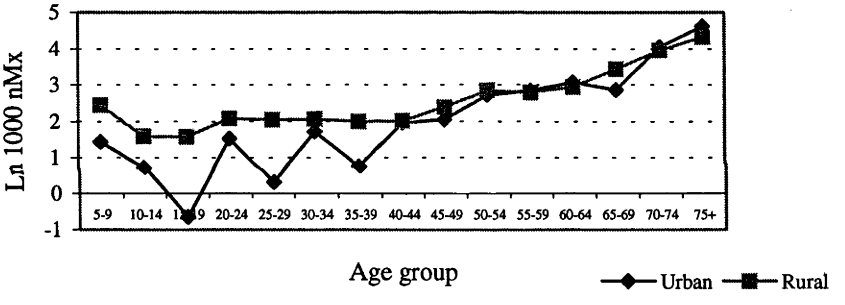


Figure 5.6.b. Adult age-specific death rates by place of residence, females, 1990



For males, at ages 5 to 39, the levels of ${}_nM_x$ in the urban areas is lower than those in the rural areas, except at the age group 30-34 where the discrepancy is probably due to sampling error. Low urban mortality is also observed at the age group 40-44. At ages 45 and over, there are no clear mortality differentials between urban and rural areas. Age misreporting and sampling fluctuation are held responsible for the zigzag pattern in the urban mortality rates.

For females, at ages 5 to 39 mortality in the urban areas is clearly lower than mortality for rural females. The fluctuation is due to sampling error and possibly age

misreporting. At higher ages there is no clear differential between urban and rural mortality.

It is also interesting to note that at the reproductive ages, except at age 40-44, urban females have on average marked mortality advantages over rural females. The contrast between urban and rural areas is clearer than for other categories. The differentials between rural and urban women during the reproductive period are believed to be mainly the result of higher maternal mortality among rural females, as the maternity clinic is one more service that so far has not existed in rural areas. The majority of rural women never receive prenatal or postnatal care (NSC, 1995b; MCHI, 1994).

Women in the rural areas marry very young, some as early as 13-14 years old (ANUTECH, 1996), and close birth spacing is often the norm of rural women (NSC/LWU, 1995). In addition to the general reproductive health problems and high fertility, women in the agrarian rural society always carry a heavy workload in the field and they are also responsible for household chores such as fetching water, cooking and child care.

Higher rural than urban mortality may be attributed to the actual state of deprivation prevailing in the rural areas. United Nations (1982:119) has argued that for least developed countries with high levels of mortality, high mortality is related to the conditions of underdevelopment itself, widespread poverty, lack of education , poor sanitary and health conditions and inadequate diet.

Transport and communication networks are important for the access to health care and other services. Unfortunately, as more than half of the rural area of Lao PDR is not accessible by road during the rainy season (NSCb, 1995) most villagers do not have easy access to a hospital or health centre. Reliable health facilities are concentrated in major urban areas (ShuiMeng, 1991; UNICEF, 1992, 1996).

Place of residence also affects people's perceptions of the outside world including cultural, social, economic and political activities. In Lao PDR, urban and rural residence serves not only to distinguish between 'have' and 'have not', but also between understanding of and reaction to sickness, and readiness to accept modern medicine.

Any kind of modern education helps to reduce mortality and this phenomenon occurs in all parts of the developing countries (Caldwell and Caldwell, 1991). Education among the rural Lao population is very low, especially among women, and half of rural females are illiterate (MCHI, 1994; World Bank, 1995b; NSC, 1995b).

Why is there no clear mortality advantage for urban population at age 45 and over for males and at ages 40 and over for females? Several of the factors already discussed will have a greater effect on the younger population than on the older population. Younger people may be more willing to undertake ardous journeys especially when sick. Younger people are more receptive than older people to modern ideas, including those relating to health and disease. Furthermore, increases in educational levels clearly affect the younger population. Evidence seems to suggest that as mortality declines, the decline happens mostly among children, to a lesser extent among young people and least among older people (UN, 1982; Ruzicka and Kane, 1987).

5. 3. 4. Differentials by ethnicity

In the discussion of mortality differentials in the Lao context, ethnicity becomes an important factor, as ethnicity determines much of the social and cultural environment in which people live and affects their behaviour particularly in their attitudes toward health (Breakey and Voulgaropoulos, 1976: 14). In general, Laoloum and Other Lao evidently have different types of farming practices, health belief and traditional practices,

and quite different kinds of food availability, preferences and nutrient intakes (Wall, 1975; Breakey and Voulgaropoulos, 1976; UNICEF, 1992; 1996).

Ethnicity is a measure of norms, traditions, attitudes, and practices that have a direct effect on health; even when other factors are controlled for, ethnicity is still related to mortality differences (Defo, 1993). Moreover, with respect to cultural differentials in child mortality, Caldwell and Caldwell (1991) cite various studies which demonstrate that in a plural society ethnicity is a strong social variable, as important as parental education in determining child mortality (Hilderbrand et al., 1985; Mensz et al., 1985 cited in Caldwell and Caldwell, 1991: 5). Mortality differentials by ethnicity are said to reflect differences in cultural practices and social status, not genetic differences (Mammo, 1993: 235).

Figures 5.7.a. and 5.7.b. show distinct levels of age-specific mortality rates between Laoloum and Other Lao. As compared to differentials observed in other population classifications, there are comparatively clear differentials in mortality between Laoloum and other Lao for both males and females.

Figure 5.7.a. Adult age-specific death rates by ethnic group, males, 1990

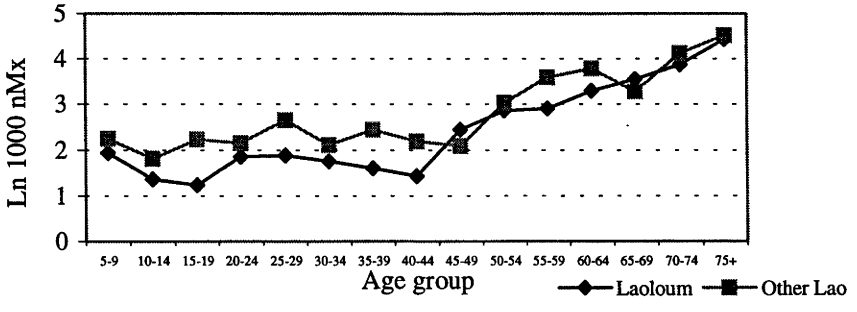
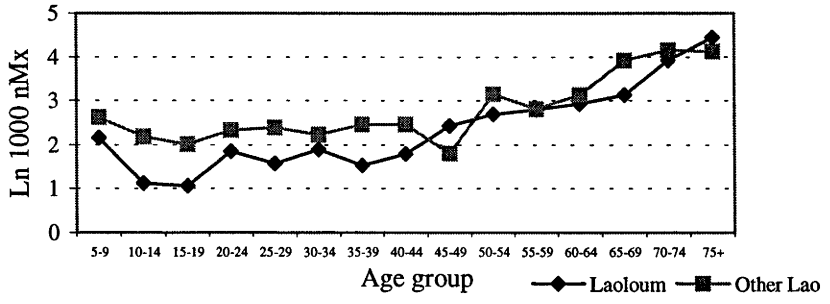


Figure 5.7.b. Adult age-specific death rates by ethnic group, females, 1990



For males, mortality rates in all the age groups 5 to 39 of Other Lao remain clearly higher than those of Laoloum. From age 40, except in age groups 45-49 and 65-69, probably due to sampling error mortality of Laoloum appears also to be lower than that of Other Lao.

For females, at ages 5 to 44, sharp differentials in the levels of ${}_nM_x$ can be seen between Laoloum females and Other Lao females. Again, the differential is less clear at older ages, with the reversal of the differential at ages 45-49 and 75+ being attributable to random fluctuation. Here again, as Other Lao make up only 20 per cent of the sample, causing large sampling fluctuation, no definite conclusion about differentials in mortality at ages above 45 can be safely made. However, the differential in favour of Laoloum at older ages would appear to be more clear than the differential in urban-rural residence.

There is a similarity in the shape of the age pattern of mortality of Laoloum and that of Lowland zone. This similarity is due to the fact that the majority of Laoloum are Lowland inhabitants. Laoloum share the advantages of accessibility to food, health care and other social services the Lowland zone.

Although the majority of hill and mountain dwellers belongs to other ethnic groups, the pattern of mortality of Other Lao does not resemble the mortality patterns of

people living in the Highland and in the north. This is because a considerable number of Other Lao, particularly those classified as Lao Theung, live among the Lao people in the Lowland and in all regions of the country including both urban and rural areas. Only the Hmong and Yao live separately and exclusively in the high altitude above 1000 metres and they constitute less than 10 per cent of the total population of the country (SSC, 1992).

Among factors believed to be important in producing mortality differentials between Laoloum and Other Lao are types of livelihood and living conditions, traditional behaviour and beliefs and attitudes toward disease and health care. Poor living conditions are believed to relate to high levels of mortality (Ruzicka and Hansluwka, 1982).

The living conditions of people classified as Other Lao are generally poorer than those of Laoloum. A large number of Other Lao are mainly hill and mountain top dwellers, and rely for their subsistence on shifting cultivation and hunting and gathering (SSC, 1992; UNICEF, 1992, 1996); the shifting cultivators are the poorest and always face food shortages (World Bank, 1995a; Lao PDR, 1996). Housing conditions and sanitation in the villages of Other Lao groups are often poor, and their nutritional intakes are usually lower in protein and micro-nutrients as they consume less meat, fish and green vegetables than Laoloum (Breakey and Voulgaropoulos, 1976).

The situation is suspected to be worse for Other Lao females as their living conditions are observed to be much poorer than those of Laoloum females. They work harder and longer (Maroczy, 1986) and are thought to receive less food than males of the same ethnic minority groups, as some tribes have the tradition of providing food to men and children first (Lebar and Suddard, 1960; Breakey and Voulgaropoulos, 1976; UNICEF, 1996). Among Lao peasants, in addition to field work like planting rice and

other crops, it is females who are mostly income earners by exploiting forest products and weaving or engaging in petty trade during the off-season (UNICEF, 1996).

Moreover, compared to Laoloum women, the status of Other Lao women is low: they are not as autonomous as Laoloum females in decision making with respect to financial matters and health care and other related matters, and very few of them receive any formal education (Batson, 1991; UNICEF, 1992). The majority of Other Lao females are illiterate (Batson, 1991; UNICEF, 1992; MCHI, 1994).

Some forms of life style and behaviour of other Lao females may be detrimental to their health. Many Other Lao women start to carry out their routine work as soon as seven days or less after giving birth. This practice coupled with inadequate nutrition could be harmful to them, as the majority of Lao women do not receive antenatal and postnatal care and 90 per cent give birth at home (MCHI, 1994). Deficiencies of iodine, iron and Vitamin A are reported to be widespread among hill tribes (Phanlavong, 1995). Frequent pregnancies adversely affect women's health, undoubtedly contributing to the anaemia which is widespread among Asian women, and increasing the risk of maternal deaths (UN, 1982).

In many ethnic minorities, particularly among Laotheung living in the plateau and lower hill areas, females have the habit of smoking pipes. Pipe smoking starts as early as eight or nine years old; it has been seen among the Laotheung in many villages in the Boloven areas that all girls as young as eight or nine years old smokes pipe with strong tobacco. Smoking among Laoloum females is extremely rare. Among mountain top dwellers of Other Lao ethnic groups, opium growing and consumption, especially among males is common, particularly among the Hmongs and to a lesser extent the Yaos, though the Yaos are better opium growers. Health belief and perception of modern health care vary greatly between Laoloum and Other Lao.

5. 4. Summary

It is clear that there are differentials in adult mortality between the different subgroups of the population examined in this analysis. These differentials can be regarded as proxies for disparities in levels of socio-economic development, in resource, in access to health care, sanitation and nutrition, in access to education and also in social and cultural belief and practices. In many parts of the world, factors associated with high mortality among the lower socio-economic groups include poor nutrition, inadequate preventive health measures, inaccessible health facilities, poor personal health practices, illiteracy, low income and poor environmental sanitation (UN, 1982: 110).

All variables used in the analysis show much clearer mortality differentials at ages less than 40 than at ages 40 above. For the population aged 40 and over, small differentials may be because their unfavourable lifetime experience such as disease environment and nutritional deficiencies and health status in more than 40 years ago which could have effects on mortality later in their life (Mosley and Gray, 1993) was similar for all populations subgroups. These are people who have been through periods of resistance war against the French colonial power, World War II, and the Indochina War, during which socio-economic status, health and nutritional levels were similarly precarious for all population subgroups, except for a handful of urban elite. Furthermore, the effects of health care are felt more among children, less among young adults, and least among the older population. Differentials in access to health care produce little mortality differentials at ages 40 and above.

At ages less than 40, mortality is lower in the Lowland zone, in the centre and in the urban areas where access to health care, sanitation is relatively good, and where socio-economic development and environmental resources facilitate more stable forms of food production and thus better nutrition. Mortality among Other Lao is remarkably high

in relation to that of Laoloum. Lack of education, fatalistic views toward health problems and traditional beliefs and cultural practices are also believed to influence the mortality differentials observed.

Chapter 6

Infant and child mortality differentials

6.1. Introduction

In almost all socio-economic aspects of human life, there are differences between people belonging in geographic areas including religious, ethnic and cultural differences. Such differences also occur within a society: one example is mortality. There is evidence from many parts of the world of substantial variations in infant and child mortality within societies, and such variations relate to demographic, economic, social and behavioural factors (Preston, 1975; Scrimshaw, 1978; United Nations, 1982; 1985, 1988). Regardless of the national levels of mortality, there are differences in child survival chances between various socio-economic subgroups within a country (Ruzicka et al., 1989: 3).

Infant and child mortality differentials exist across biological and demographic characteristics such as sex of the child, mother's age at birth and birth order; socio-economic characteristics such as parental education and place of residence; and environmental factors such as sanitation, drinking water and health care services (Meegama, 1980; UN, 1982; Rutstein, 1983; Trussell and Hammerslough, 1983; Martin et al., 1983; Al-Kabir, 1984; Hobcraft et al, 1984; UN, 1985). In addition to socio-economic differences, both at the household level and at the community level (Ruzicka et al. 1989), infant mortality is influenced by disease environment and ecological differentials (UN, 1985).

Infant and child mortality for Lao PDR for cohorts born between 1965 and 1994 by sex of the child and period of birth have already been examined in Chapter 3. This chapter examines infant and child mortality differentials by mother's age at childbirth, birth order, region, urban or rural place of residence, parental education and occupation.

These variables, some of which other studies have been shown to have strong influences on infant and child mortality, are hypothesized to produce significant mortality differentials in the Lao context. The significance of mortality differentials between two or more categories within one variable is tested by the Gehan (Wilcoxon) test, discussed in Chapter 3.

Infant, child and under-five mortality rates presented are probabilities of dying during infancy, ${}_1q_0$, from age 1 to 4, ${}_4q_1$, and from birth to age five, ${}_5q_0$, respectively multiplied by 1000. The discussion however is mainly based on infant and child mortality, as under-five mortality rates are computed from infant and child mortality and are given for the sake of completeness of mortality indices only. It was pointed out in Chapter 3 that under-five mortality is heavily weighted by infant mortality.

6. 2. Differentials by demographic factors

Table 6. 1. gives the infant, child and under-five mortality rates according to different categories of mother's age at childbirth and birth order. Tests of differences in survival levels between age categories of mothers and birth order are also included in the last row for each variable.

6. 2. 1. Differentials by mother's age at childbirth

The differences in survival levels according to mother's age at childbirth are very highly significant. The pattern of infant mortality according to mother's age at childbirth evidently displays a U-shaped pattern, such as is found other developing nations in Africa, Latin America and other Asian countries (Arriaga and Hobbs, 1982; Rutstein, 1983: 27; Al-Kabir, 1984:15; Hasmiyati et al., 1997: 26). In general, the U-shaped relationship is found to be very strong for infant mortality but less so for child mortality (Rutstein, 1983: 27).

Table 6.1. Infant, child and under-five mortality rates by mother's age at childbirth and birth order and Gehan statistics, Lao PDR 1965-94, FBSS, 1994.

Variable	Infant mortality $_1q_0$	Child mortality $_4q_1$	Under-five mortality $_5q_0$
Mother's age at childbirth			
<20	184.9	73.9	245.1
20-24	123.8	68.6	183.9
25-29	103.0	71.2	166.9
30-34	106.1	70.5	169.1
35-39	103.1	63.8	160.3
40+	131.9	62.1	185.8
Gehan statistic = 180.765; Degrees of freedom = 5; p = 0.0000			
Birth order			
1st order	144.0	52.5	188.9
2nd –3rd order	115.1	70.1	177.1
4th – 5th order	111.9	78.9	182.0
6th and higher	135.1	84.6	208.3
Gehan statistic = 18.413; Degrees of freedom = 3; p = 0.004			

Source: FBSS childfile, using *SPSS* life table survival analysis.

The U-shaped relationship is not found in the case of child mortality. With the exception of children born to mothers aged 20-24, the child mortality pattern by mother's age at childbirth shows a decrease pattern with increasing age. This pattern of child mortality according to mother's age at childbirth is also observed in Bangladesh where shows that child mortality declines continuously with mother's age, demonstrating that older mothers are more experienced in child care (Al-Kabir, 1984: 14).

6. 2. 2. Differentials by birth order

The differences in survival levels according to birth order are also highly significant. The pattern of infant mortality by order of birth also displays a U shape, with high infant mortality for first-order births and for births of sixth and higher orders. The lowest level of infant mortality is found for fourth and fifth births. The U-shaped

pattern of infant mortality is a common feature in many countries of the developing world as shown by the World Fertility Survey (Rutstein, 1983).

The possible explanations for the U-shaped relationship between infant mortality and birth order are that on the one hand, first-born children are more likely to be born to a mother who is biologically, mentally, socially and economically unprepared to bear and bring up a child. On the other hand, children of high birth orders are more likely to be born to mothers who are physically more worn out and older, are more likely to be affected by competition from older siblings in terms of food and other family resources, are more likely to be cared for by someone other than the mother, especially an older sister, and are more likely to be considered superfluous. Moreover, since women of higher socio-economic status are likely to have smaller families than those of lower status, a disproportionately large share of children of high birth orders come from families of lower education and income (Rutstein, 1983: 29).

With respect to child mortality, it is found that first births have the lowest level of mortality and that mortality increases with the order of birth. The finding is similar to findings of the WFS, where mortality rises sharply with birth order for all countries under consideration, the likely joint causes being low socio-economic status and unrestricted fertility (Rutstein, 1983: 29).

It can be noted from Table 6. 1. that the direction of child mortality according to mother's age at birth is opposite to that according to birth order. As mentioned above the high risk of mortality among children of young mothers is because of first births to young mothers who are not biological, mentally and economically ready to bring up a child and as mother's age increases the risk of child mortality to the first birth actually decreases (Rutstein, 1983; Martin et al., 1983: 429). Higher child mortality at higher birth orders reflects the detrimental effects of competition among siblings in large

families for food and care, and increased risk of disease transmission (Winikoff and Castle, 1987). Because mothers are already overburdened by routine work, children in large families are at risk of being left to fend for themselves in a situation often referred to as unintentional negligence (Scrimshaw; 1978). High child mortality among children of high-parity women is also attributable to being born with low birth weight as a result of maternal depletion caused by frequent and closely-spaced childbearings (Winikoff and Castle, 1987), which continue to produce negative effects on survival into childhood ages (Hobcraft et al., 1983). On the average, the interval between births is short for Lao women, less than two years (NSC/LWU, 1995). The association between mortality risk and parity can also arise from the fact that women who experience child deaths may continue to have more children than those whose children survive, through either intention or physiological replacement mechanisms (Zaba and David, 1996: 266).

6. 3. Differentials by region and urban or rural residence

Region and urban or rural residence serve as proxies for variations in the levels of socio-economic development and disparity in access to services. Table 6. 2. displays infant, child and under-five mortality according to region and urban or rural place of residence.

Table 6.2. Infant, child and under-five mortality rates by region and urban-rural place of residence and Gehan statistics, Lao PDR 1965-94, FBSS, 1994.

Variable	Infant mortality $_1q_0$	Child mortality $_4q_1$	Under-five mortality $_5q_0$
Region			
North	120.4	87.1	197.0
Centre	127.0	65.0	183.7
South	124.6	62.5	179.3
Gehan statistic = 2.812; Degrees of freedom = 2; p = 0.2451			
Urban-rural place of residence			
Urban	78.5	27.4	103.7
Rural	136.6	82.0	207.4
Gehan statistic = 240.121; Degrees of freedom = 1; p = 0.0000			

Source: FBSS childfile, using *SPSS* life table survival analysis.

Table 6. 2. shows that differences in survival levels between different regions are not statistically significant. The apparent lack of infant mortality differentials between the three regions can be attributed to the compositional structure of the centre. The centre has the main urban centre, Vientiane, as well as the province, Savannakhet, which is largely rural. More than fifty per cent of total doctors in the whole country are concentrated in Vientiane Municipality alone. At the same time, Savannakhet constitutes 17.4 per cent of the sample, but 23-24 per cent of the total number of women with no education, illiterate and with husbands with no education. The rural component of Savannakhet is 90 per cent, 10 per cent higher than the national average. This means that centre is the average of the main urban centre and a very large undeveloped area, and the effects on infant mortality of this average are about the same as the development of the other two regions.

Infant and child mortality differentials are further examined by considering Savannakhet province separately from the centre. When Savannakhet is considered separately, differentials in survival chances between the resulting four geographic areas are very highly significant at 0.1 level of significance. Without Savannakhet, the centre significantly has the lowest infant and child mortality. The compounding effect of the concentration of large cities and lowland plain with better communications and relatively easy access to services for the centre become apparent. The infant mortality rate for the centre is only 107 as opposed to 120 for the north and 125 for the south. The infant mortality rate for Savannakhet province is alarmingly high, 171 infant deaths per thousand live births.

Table 6. 2. shows that unlike infant mortality, child mortality in the north is markedly higher than in the other two regions, a clear indication of the stronger effects of socio-economic factors during childhood. This is because, as discussed in Chapter 5,

the north is the least developed region compared to the centre and the south, and this lack of development is translated into higher child mortality.

Survival chance differentials between urban and rural areas are highly significant. In particular, child mortality differentials between urban and rural areas are more striking than infant mortality differentials, again suggesting stronger socio-economic influences felt on child mortality. Child mortality for rural areas is more than double that in urban areas. Infant mortality is influenced by both endogenous factors, especially during the neonatal period, and exogenous factors (Al-Kabir, 1984). Exogenous factors including socio-economic conditions and cultural and behavioural factors affect mortality during later infancy and childhood more than during early infancy (Meegama, 1980; Trussell and Hammerslough, 1983; Hobcraft et al., 1984). As gaps in socio-economic conditions and living standards between urban and rural areas widen, so do child mortality differentials. Meanwhile, neo-natal mortality from endogenous biological factors, such as congenital malformation and neonatal tetanus, is reported to account for more than half of infant deaths in both urban and rural areas, though urban areas seems to be in a better position due to the presence of maternity clinics and better coverage by the immunization program (MCHI, 1994).

Higher rural infant and child mortality in the Lao PDR can be undoubtedly attributed to the fact that health care and medical networks in rural areas are weak or almost non-existent, while the urban population enjoys modern hospital and health care services (UNICEF, 1996). Higher rural infant mortality is also a feature of many other parts of Asia (Ruzicka and Hansluwska, 1982; UN, 1985).

Urban-rural differentials in infant and child mortality can be attributed not only to the concentration of services in cities and large towns and the underdeveloped state or high cost of transport between rural areas and urban centres, but also to the

differences in the socio-economic structures of the two populations. Evidence from other parts of Southeast Asia shows that lower mortality in urban areas is due to the higher socio-economic status, including higher education, income and better housing, of the urban population (Ruzicka and Hansluwska, 1982: 106).

In the Lao PDR, the FBSS data reveal that of mothers in the rural areas, 54 per cent have no schooling and 82 per cent are engaged in agricultural activities, compared with 20 per cent and 32 per cent for urban mothers. Only 9 per cent of rural mothers have education higher than primary level as against 37 per cent of urban mothers. The percentage distribution of fathers with no education is 28 per cent of rural and 9 per cent of urban fathers. About 90 per cent of rural fathers' economic activities are in the agricultural sector, while the corresponding figure for urban fathers is 35 per cent.

Feeding practices are also linked to high mortality in rural areas. It is observed that most rural mothers are unaware of the good effect of colostrum, and the kind of supplementary food to be given to infants in addition to breast milk besides chewed sticky rice (UNICEF, 1996). The value of nutritious or hygienic feeding is unknown to rural women. Traditional superstition and lack of access to the modern health system, and ignorance, particularly with respect to prenatal and antenatal care and immunization, contribute to higher rural infant and child mortality (UNICEF, 1996).

6. 4. Differentials by maternal and paternal education

Parental education is recognized to be a strong determinant of infant and child mortality in various settings, especially maternal education (Caldwell, 1979; Cochrane, 1980; Hobcraft et al., 1984; UN, 1985). The inverse linear relationship between mortality and education found in many developing countries is more pronounced in childhood than in infancy (Martin et al., 1983; Cleland and van Ginneken, 1989).

Education in Laos is also found to be linked to sanitation and infant mortality (MCHI, 1994), and to nutrition and poverty (World Bank, 1995b).

In many studies mother's education is found to be a stronger determinant of infant and child mortality than other factors such as father's education or occupation, even after other variables are accounted for (Caldwell, 1979; Cochrane et al., 1980; Arriaga and Hobbs, 1982; Hobcraft et al., 1984; UN, 1985; Cleland, 1990). A study in a Sri Lanka, however, found that mother's education was not as strong a predictor as father's education (Trussell and Hammerslough, 1983). In most contexts, even a slight exposure of the mother to formal schooling is related to reduced risk of infant and child mortality (Cleland and van Ginneken, 1989: 82).

Various mechanisms through which mother's education influences mortality have been widely explored. Education gives women autonomy and changes the direction in allocating family resources from older to younger generations within the family or from male to female members of the family (Caldwell, 1979, 1986). Hobcraft et al. (1984: 220) suggest that education plays an important role in diffusing knowledge of medical and sanitary requirements, which can range from simple elements of child care to a more complex knowledge of what drugs and vaccinations are required and the ability to find and use services. An educated woman is more likely to seek medical treatment in time for her own sickness and that of her child, and her husband tends to respect her decision and is willing to pay for the treatment required (Orobuloye and Caldwell, 1975). Education helps women to identify themselves with modern institutions and technology including health care and sanitation practices (UN, 1985), which means that education gives women social identification, cognitive skills and ability to handle administrative matters (Cleland, 1990). Education also changes women; behaviour regarding cleanliness and sanitation (Lindenbaum, 1990).

Most of the studies of the relationship between education and mortality focus more on the mother's education than on that of the father (UN, 1985) because it is generally accepted that it is women who care for children (Hobcraft at al., 1984; UN, 1985). However, in some places such as Sri Lanka (Trussell and Hammerslough, 1983), Indonesia (Martin et al., 1983) and countries in Latin America (Hobcraft et al., 1984), father's education is found to be a more important determinant of child mortality than mother's education. This could be due to the fact that women's education in many Asian countries is not pervasive (Hobcraft et al., 1984).

In the Lao context, father's education is an indicator of family welfare and social position, as educated men are more likely to find a job in the public or private sectors and more likely to engage in a lucrative trade or use modern technology in production. Father's education is also a proxy for the better perception of the values of modern health care, particularly among ethnic-minority patriarchal groups where male decisions about family matters, including health care, are predominant.

Table 6. 3 gives the infant, child and under-five mortality rates by parental education. An explanation is needed for the classification of parental education. Before 1975, primary education consisted of six grades, but since then it has consisted of five grades only. The primary education category used here comprises those with 1 to 6 years of schooling. The above-primary category include those with education for seven years or more.

Infant and child mortality differentials according to parental education are very highly significant. Table 6. 3. confirms that in the Lao PDR paternal education is almost as important as maternal education. For both variables, infant and child mortality progressively decreases as educational level rises.

Table 6. 3. Infant, child and under-five mortality rates by parental education and Gehan statistics, Lao PDR 1965-94, FBSS, 1994.

Variable	Infant mortality $_1q_0$	Child mortality $_4q_1$	Under-five mortality $_5q_0$
Maternal education			
None	153.5	91.1	230.6
Primary	108.8	61.2	163.3
Above primary	73.8	25.7	97.6
Gehan statistic = 351.309; Degrees of freedom = 2; p = 0.0000			
Paternal education			
None	159.1	94.4	238.5
Primary	134.2	78.3	202.0
Above primary	84.2	40.4	121.2
Gehan statistic = 306.305; Degrees of freedom = 2; p = 0.0000			

Source: FBSS childfile, using *SPSS* life table survival analysis.

It is also seen in Table 6. 3. that the effect of mother's education on mortality is more strongly felt during childhood than in infancy. The infant mortality rate for children born to mothers without schooling is twice of that for those born to mothers with education above primary level. The child mortality rate for mothers without schooling is more than three times that for mothers with education above primary school. Infant mortality differentials between mothers with no education and those with primary level are larger than infant and child mortality differentials between mothers with primary level education and those with above primary education, while the opposite is true for child mortality.

The infant and child mortality differentials between categories of fathers with no education and those with primary education is smaller than differentials in infant and child mortality found between fathers with primary education and those with above primary education. As paternal education is a proxy for social status and family income, this pattern may mean that men with only primary education do not have much better economic opportunities than those without education. A study found that there was a correlation between poverty and education (World Bank, 1995b). Primary education

only is not likely to equip men with any vocational skills needed for well-paid jobs, therefore jobs performed by men with only primary school are not likely to bring significantly larger economic returns than those of men without education.

6. 5. Differentials by occupations of parents

It should be noted that occupation for both fathers and mothers depends on the question about the economic activity in which the fathers or mothers spend most of their time, and which they perceive as the main job. It is not necessarily the main source of income or support for the family. It is often the case that a family's main income comes from an activity which requires relatively little time to perform.

The category of farming and farm-related activities covers all occupations in the agricultural sector: permanent rice farming, shifting cultivation, vegetable and orchard cultivation, animal husbandry, forestry and hunting and fishing. In this category, it is rare to find anyone who relies on one specific activity for their living. Most farmers either practise permanent rice farming or shifting cultivation, combined with vegetable growing, livestock raising, and from time to time fishing.

For maternal occupation, the trade and others category includes also those reported as housewives, clerical jobs in the private sectors and crafts such handloom weaving and dressmaking. These occupations are grouped together because of the small number of cases represented in the sample. In the total economy of Lao PDR, such occupations are minimal and they are mainly found in urban areas. It is almost impossible to find any women who are only housewives attending to family chores and raising children. Those reported as housewives normally carry on petty trade at home by selling groceries or prepared food and beverages, and in rural areas in most cases they also work in the fields.

The government employee category is self-explanatory. This category includes people in the army and police and those working in the state-owned enterprises, as they are entitled to the same benefits as those working in other public services. The majority of government employees, particularly those living outside urban centres, also engage in farming or husbandry, which for most proves to be the main source of income for family support.

Mother's economic activity is believed to be indicative of time spent in child rearing and domestic activities (UN, 1985: 150). Hobcraft et al. (1984) found that in 28 countries under study, mother's work status generally yields smaller differences in infant mortality than in the case of father's occupation. Mother's occupation is not likely to be an important explanatory variable of infant and child mortality, except for neonatal mortality in a few countries (Hobcraft et al. 1984: 207).

Table 6. 4. gives infant, child and under-five mortality rates according to occupations of mothers and fathers. It is apparent that there are highly significant infant and child mortality differentials by occupations of parents.

Table 6. 4. Infant, child and under-five mortality rates by occupation of parents and Gehan statistics, Lao PDR 1965-94, FBSS, 1994.

Variable	Infant mortality $_1q_0$	Child mortality $_4q_1$	Under-five mortality $_5q_0$
Mother's occupation			
Farmers	134.7	79.5	203.5
Public servants	79.2	24.7	101.9
Trade and others	101.4	48.9	145.3
Gehan statistic = 112.89; Degrees of freedom = 2; p = 0.0000			
Father's occupation			
Farmers	136.0	80.7	205.7
Labour and others	81.0	34.8	113.0
Public servants	78.5	25.6	102.1
Trade and other professionals	102.8	50.3	147.9
Gehan statistic = 209.286; Degrees of freedom = 3; p = 0.0000			

Source: FBSS childfile, using *SPSS* life table survival analysis.

Infant and child mortality rates by mother's occupation are the highest for mothers in farming and lowest for mothers who are public servants. Infant and child mortality for mothers engaged in trade and other miscellaneous jobs, which are mixed occupations, is intermediate.

The fact that the survival chances of children born to mothers working in the public sector are relatively high is not because they receive higher income than others; in fact their salaries are less than those engaged in the private sector or self-employed. Some women carrying on trade in fresh food or groceries earn in a few days more than a government employees would earn in a month. Among the three categories of mother's occupation, in terms of cash income government employees rank the lowest.

Mother's occupation here is more likely to be a social indicator. In terms of time spent on child rearing, mothers in the public sector have more time to take care of their children. Mothers in the public sector also enjoy hospital delivery and long maternity leave. Until recently, all public offices had creches with professional nurses to care for children while their mothers were working and they are located in the same premises as the offices. Kindergarten was also provided free of charge for the children of public servants and in most cases were run by the agencies in which parents worked. In rural provinces or districts, where child care and creches are not available, women working in the public service always bring their babies or small children to their offices, where they spend most of their time caring for their children instead of working as there is not much office work to perform in many local government offices. In addition, in places where government offices are located, a health centre, a dispensary or a hospital is also situated in the vicinity, and until the late 1980s there was a paramedic or physician assigned to nearly every major government department, at both the central and local levels.

In addition, there are correlations between mother's occupation and other variables like place of residence and education. The majority of places where public offices are located are classified as urban areas. Mothers who are government employees but classified as rural are those who live in the rural villages and commute to work, and there are very few of them. The majority of mothers working in the public sector are those with above primary school education. While there are a number of mothers with primary school education only, these constitue only 1.3 per cent of all public servant mothers

The public servant category corresponds very closely to the above primary education category for women, and the results of the analysis are very similar for educated women and women in the public service. Until recently there was almost no employment outside the public sector for females with education (UNICEF, 1996). The recently established textile industry and private enterprises offer many employment opportunities for females, but mostly young and unmarried ones, and they receive quite low salaries and have to work long hours (UNICEF, 1996).

A family's socio-economic status is said to influence consumption standards among children and affect their health and survival, and father's occupation is a proxy for household's consumption standards (UN, 1985: 125). It is also claimed that the quantity and quality of nutrient intakes, housing quality, clothing, family sanitation and hygienic standards, and the medical care are all affected by the socio-economic position of the family (UN, 1985). The father's economic activity continues to have a distinct and substantial effect on infant and child mortality (UN, 1982: 110).

In addition to the categories of occupation listed for mothers, father's occupation also includes a category of labourers and others. This category includes all permanent or casual labourers, and they mainly work for wages instead of salaries. These are workers

in the private enterprises, coolies and daily wage workers in the construction, transport or service industries whose employment is required only occasionally. Included in this category can be labourers in the agricultural sector at the peak of the production and harvest seasons, and those in the informal sector.

It should be stressed again that in the Lao context, father's occupation is not a good indicator of income differentials. The income of public servants is less than the income of those engaged in the private sector, except for farmers (World Bank, 1995b). Although it is estimated that women contribute largely to family income, it is traditionally expected that the man is the main pillar of family wellbeing and survival, and women care for children and undertake family chores. To a large extent, father's occupation reflects the level of consumption of the family in addition to being a measurement of family social status.

Table 6.4 shows that infant and child mortality is lowest for fathers engaged in the public service and highest for fathers working in agriculture. In between these two categories, infant and child mortality for fathers as labourers and others is lower than fathers engaged in trade and other professionals.

A high level of infant and child mortality among fathers engaged in agriculture is also observed in many countries in the developing world. It is found in univariate analysis that in Africa, Asia (except Republic of Korea) and Latin America, children born to fathers working in the agricultural sector experience higher mortality relative to other categories (UN, 1985: 133).

It is interesting to note that mortality for fathers as labourers and others is lower than those with fathers engaged in trade and other professionals. It would normally be expected that those employed in trade and professionals would have higher income and hence better living standards for their families. In other studies, it is found that children

of fathers in sales, professional and clerical positions have the lowest mortality (UN, 1985; Hobcraft et al., 1984). The differentials in mortality become smaller, however, when other factors, particularly education, are accounted for (UN, 1985).

Higher infant and child mortality recorded for children to fathers in the trade and professional sector may be due to the fact that this category is not restricted to white-collar professionals and affluent merchants. It covers a whole range of activities ranking from executives of private firms, wholesalers and retailers, street vendors, technicians and craftsmen in big cities and towns with incomes much higher than the rest of the population, to retail traders, inter-town mobile merchants, those engaged in petty trade and grocery sale in house porches and village craftsmen, with hardly enough income to support families. Labouring and other related activities are mostly available in the cities and towns only. Information from this data set suggests that 69 per cent of the labourers and others related activities are located in urban areas. The distribution by place of residence for the trade and professional category is less uneven, with 51 per cent found in the urban areas. Therefore, structural factors of place of residence among labourers and others may contribute to the better survival chances among their children.

6. 6. Bivariate analysis

The foregoing analysis considers the individual effects of each independent variable on infant and child mortality. It is interesting to know if the observed effect of each variable remains significant in the presence of other variables. For example, elsewhere it is found that urban-rural mortality differentials are attenuated when maternal education is controlled for (UN, 1985), and in some cases, for instance in Sri Lanka, mortality differentials even change direction from higher rural child mortality to higher urban child mortality when other variables are accounted for (Trussell and

Hammerslough, 1983). This section looks at infant and child mortality according to parental education by urban or rural place of residence, and according to mother's and father's occupation by parental education. Table 6. 5. 1. presents infant and child mortality according to place of residence and parental education.

When urban or rural place of residence is controlled for, differentials in mortality by maternal education as well as by paternal education remain highly significant. Maternal education is a very important factor determining mortality in both urban and rural settings, as is paternal education.

Survival chances in infancy and childhood are improved with increased maternal and paternal education in the presence of health services and good economic opportunities in urban areas or in the absence of these in rural areas. As in the case of rural Lao villages where differences in education do not mean differences in employment opportunities, which generally do not exist, this pattern supports the view of Cleland and van Ginneken (1989) and Lindenbaum(1990) that maternal education, even at a very elementary level, changes certain attitudes and behaviour towards diseases and child care which in turn help reduce the risk of mortality among children born to mothers with at least some education.

Table 6. 5. 2. presents mortality rates for parental education and parental occupation. The table shows that when maternal education is taken into account, the effects of maternal occupation on infant and child mortality remain significant only if mothers have no schooling or primary school education. Maternal occupation has no statistically significant effect if mothers have education above primary level.

Table 6. 5. 2. also shows that for all categories of paternal education, father's occupation is still an important factor in determining infant and child mortality differentials. The somewhat lower level of significance for mortality differentials by

Table 6.5.1. Infant and child mortality according to urban -rural place of residence and parental education, Lao PDR 1965-94, FBSS, 1994

	Urban-rural place of residence	
	Urban	Rural
Maternal education		
	Infant mortality	
None	118.1(923)	156.9(9687)
Primary	76.8(1967)	118.2(6754)
Above primary	58.4(1661)	90.1(1565)
	Child mortality	
None	48.4(723)	95.5(6942)
Primary	27.0(1590)	72.5(4843)
Above primary	15.9(1260)	37.3(1073)
Gehan statistic	53.598	160.737
df	2	2
p	0.0000	0.0000
Paternal education		
	Infant mortality	
None	116.9(411)	162.5(4996)
Primary	84.1(1296)	141.4(8961)
Above primary	70.3(2844)	93.9(4048)
	Child mortality	
None	53.0(321)	98.1(3537)
Primary	32.9(1035)	85.7(6362)
Above primary	21.2(2219)	54.8(2958)
Gehan statistic	30.239	146.158
df	2	2
p	0.0000	0.0000

Source: FBSS childfile, using *SPSS* life table survival analysis.
Notes: Figures in brackets represent the number of cases at risk.
df: degrees of freedom
p: level of significance

father's occupation for fathers with no education is likely to be due to the fact that there are no deaths recorded for children whose fathers are public servants with no education, whose number is only 11. If fathers have no education, it is children of those engaged in trade and other professional jobs who experience the highest level of infant mortality.

Table 6. 5. 2. Infant and child mortality according to occupations of parents and parental education, Lao PDR 1965-94, FBSS, 1994

Mother's occupation	Mother's education		
	None	Primary	Above primary
	Infant mortality		
Farmers	158.0(8834)	112.3(6119)	83.4(1343)
Public servants	100.0(20)	71.1(113)	80.2(487)
Trade and others	131.5(1756)	102.0(2489)	62.3(1396)
	Child mortality		
Farmers	93.5(6341)	69.9(4451)	30.9(937)
Public servants	117.6(17)	43.7(92)	14.9(336)
Trade and others	78.7(1308)	41.8(1890)	24.5(1060)
Gehan statistic	11.683	11.09	3.836
df	2	2	2
p	0.0029	0.0039	0.1469

Father's occupation	Father's education		
	None	Primary	Above primary
	Infant mortality		
Farmers	160.8(5123)	140.0(8842)	92.6(3759)
Labourers	93.5(161)	86.0(651)	75.0(867)
Public servants	...	116.5(395)	70.8(1823)
Trade and others	186.7(113)	97.7(369)	85.8(443)
	Child mortality		
Farmers	95.5(3645)	83.5(6313)	55.0(2782)
Labourers	64.5(124)	35.4(509)	28.7(661)
Public servants	...	41.8(287)	21.7(1385)
Trade and others	88.6(79)	76.4(288)	20.1(349)
Gehan statistic	8.928	40.264	34.003
df	3	3	3
p	0.0303	0.0000	0.0000

Source: FBSS childfile, using *SPSS* life table survival analysis.
Notes: Figures in brackets represent the number of cases at risk.
df: degrees of freedom.
p: significance level
... No occurrence of deaths or the number of cases too small, < 20.

6.7. Summary

There are significant infant and child mortality differentials according to the demographic and socio-economic characteristics under consideration. Infant mortality is not surprisingly found to be highest for children of mothers aged less than twenty years old and for first birth order. Child mortality, except for the 20-24 age group of mothers, decreases with age of mother at childbirth, and the opposite is true with birth order.

Mortality is also the highest if children are born in the rural areas or to parents without schooling or who are farmers.

There are no significant infant and child mortality differentials by region because the centre also includes Savannakhet, the largest province in the country with the highest mortality rate in the country. However, when the country is split into three regions and Savannakhet, it is found that there are also significant mortality differentials between the centre and the other two regions. The centre experiences the lowest infant and child mortality, mainly because of the concentration of major urban centres with health facilities in the centre and its better transport and communication systems. Judging from under-five mortality, of all the three regions it is the north that experiences the highest mortality level.

Mortality in the rural areas is as high as twice that in the urban areas. Mortality differentials according to urban or rural place of residence maintain their very high significance even when other factors such maternal and paternal education are taken into account; this indicates the importance of the differences in the availability and access to health care, sanitation and other socio-economic indicators, and health beliefs and health seeking behaviour, between urban and rural areas. A finding similarly observed in all other studies (Caldwell, 1979; Cochrane and Leslie, 1980; Hobcraft et al., 1983) is that there are also significant mortality differentials by education of mothers and fathers, with mother's education exerting stronger influences on survival chances.

Particularly in rural areas, there are substantial differentials in infant and child mortality between parents with no education and those with some education, especially those with education above primary school. This seems to indicate the importance of parental education, particularly that of mothers, in reducing infant and child mortality in

the near-absence of health care provision and in the least developed socio-economic conditions.

Infant and child mortality experience differs according to types of parental economic activities. Unlike findings in other places where children of clerical and professional fathers experience the lowest mortality level (Meegama, 1980; Hobcraft et al., 1984; UN, 1985), in Lao PDR it is the children whose fathers or mothers are public servants who experience the lowest mortality level, not because of their higher income but because of better access to health care and better education. There are no statistically significant mortality differentials according to mother's occupation if mothers have education above primary level, whereas infant and child mortality differentials by father's occupation are highly significant for all categories of education. This apparently leads to the conclusion that father's occupation is more important than mother's occupation in determining infant and child mortality as it can represent family economic resources.

There are certainly interrelations among the covariates under study in influencing infant and child mortality (Meegama, 1980; Trussell and Hammerslough, 1983; Linda et al., 1983; Al-Kabir, 1984; Hobcraft et al., 1984). The analysis so far has provided some ideas about the strength and directions of the determinants of infant and child mortality, but not how they interact in conjunction in producing mortality differentials. The compounding effects of the socio-economic variables as predictors of infant and child mortality are examined in the multivariate analysis in Chapter 7.

Chapter 7

Multivariate analysis of infant and child mortality determinants

7. 1. Introduction

It has already been seen in Chapter 6 that infant and child mortality varies according to different characteristics of the population, and that the tenacity of differentials in survival levels according to one independent variable alters when another is also considered. As suggested by other studies (Meegama, 1980; Al-Kabir, 1984; Hobcraft et al., 1984; UN, 1985), there are inter-correlation among the covariates under investigation. The predictive power of some covariates changes when other variables are added to the analysis. For example in the Philippines, univariate analysis found that urban child mortality is lower than rural, but when other socio-economic factors are added to the model the reverse is true (Martin et al., 1983: 422). For both the Philippines and Indonesia, regional childhood mortality differentials change markedly when many variables are simultaneously added to the model (Martin et al., 1983: 428). In the multivariate analysis of child mortality for Sri Lanka, it is also found that urban mortality is higher than mortality in rural estates, while the univariate analysis points to the contrary (Trussell and Hammerslough, 1983: 17). These studies suggest that univariate and bivariate analyses are often inadequate for explaining variations in infant and child mortality because many factors either interact or reinforce each other in determining mortality. Whether the simultaneous effects of multiple covariates can change the mortality differentials observed in the univariate and bivariate analyses as seen elsewhere, and whether the predictive power of each covariate will diminish or increase when other

factors are controlled for, are questions that need to be addressed by the multivariate analysis in this chapter.

In order to evaluate the effects of various covariates simultaneously, Cox regression analysis is used in this chapter to examine the effects of demographic and socio-economic variables on infant and child mortality. As in the case of the life table analyses in Chapter 3 and Chapter 6, the multivariate analysis in this chapter employs data from the 1994 Lao Fertility and Birth Spacing Survey (FBSS). The analysis in this chapter employs two types of models, a univariate model in which only one covariate is entered in the model and a multivariate model for considering simultaneously several covariates.

7. 2. Models

In this kind of survival analysis it is not the number of events (deaths) in an age interval that is of interest but rather the time to the occurrence of the event. Therefore, the dependent variable is a time-to-event variable: duration from the beginning of the relevant age interval to death. Since not all children will die during the age interval under study, censored cases are introduced. In this analysis mortality during the interval from birth to age 5 is treated as the dependent variable. Independent variables or covariates of mortality include biological, demographic and socio-economic characteristics.

The method most appropriate for multivariate analysis of this type of data is 'Cox regression', provided by the "*Coxreg*" procedure in the "*SPSS*" statistical software (Retherford and Choe, 1993). Cox regression is a method for modelling the relationship between time to an event and a set of covariates in the presence of censored cases; that is the event of interest need not occur for all cases (SPSS-Help Menu, 1997). The Cox regression procedure also produces the *Wald* test value and corresponding probability

value which indicates the importance of an association of a particular covariate with the mortality risk.

The Cox regression or multivariate life table method, first considered by Cox (1972), assumes that the probability of occurrence of the event remains constant within each age interval but allows it to vary according to the socio-economic or demographic covariates under study. It is also assumed that all the covariates must be categorical.

Cox regression uses all information from all cases and takes into account specific information on age at death rather than the proportion dying before a given age. Its measures the precise time between certain reported events, such as from birth to the occurrence of death. It allows estimation of the empirical survival distribution functions and levels irrespective of the age of the child at the time of the survey. Therefore, the effects of several socio-economic variables on infant and child mortality can be evaluated using information for all births covered by the survey. It is not restricted by truncation problems.

Cox regression is a proportional hazard model. In the case of proportional hazard models, the hazard is not only a function of time, but also a function of predictor variables specified in the model (Retherford and Choe, 1993). In proportional hazard models, there is no interaction between the age interval and the covariates. In this case, there is a fixed underlying hazard function which is the same for all individuals. The effect of covariates is to raise or lower this underlying hazard function by a multiplicative factor that is the same for all ages (Cox, 1972; Trussell and Hammerslough, 1983).

The hypothesis upon which this type of model is based is that the hazard function for any combination of covariates possesses the following simple relationship to the hazard function for some base category of respondents:

$$h = h_0 \cdot \exp(b_1(x_1) + b_2(x_2) + \ldots + b_n(x_n)) + e$$

where h is the hazard function for an individual with covariates x_1 to x_n, h_0 is the hazard function for the base category, and b_i are unknown regression coefficients associated with covariates x_i, where $i = 1$ to n. The estimated effect of a covariate is always positive and monotonic. If b is the regression coefficient of a covariate, one unit increase in the covariate, *ceteris paribus*, will multiply the hazard function by exp(b).

The above model can be expressed in the form of a linear model, except that there is no constant term. The constant term in a sense is the logarithm of the baseline hazard, $\ln(h_0)$, separated from the linear part of the expression. This constant term is dependent on the choice of base category. Dropping the error term, the model can be expressed in a linear form as:

$$\ln (h/h_0) = b_1 (x_1) + b_2 (x_2) + \ldots + b_n (x_n)$$

Most importantly, the model provides the relative risk which is the value of h/h_0 or exp(b) for each category of each covariate in relation to the baseline category. The relative risk, h/h_0, tells the multiplicative difference between the hazard for each category of each covariate and the baseline function. A value of the relative risk of more than 1 means that the covariate increases the hazard, or decreases the probability of survival; if it is less than 1, the opposite is true.

7. 3. Covariates used in the analysis

Definitions and percentages out of total births of covariates used in the multivariate analysis are given in Table 7. 1.

Table 7.1. Definitions of covariates and their percentage distribution.

Characteristics	Number of births	Percent of total births
Maternal education		
None	10,890	46.8
Primary	9,013	38.7
Above primary	3,366	14.5
Paternal education		
None	5,555	23.9
Primary	10,586	45.5
Above primary	7,128	30.6
Mother's occupation		
Farmers	16,807	72.2
Public servants	645	2.8
Trade and others	5,817	25.0
Father's occupation		
Farmers	18,289	78.6
Labourers	1,729	7.4
Public servants	2,304	9.9
onals	ç	
Urban-rural residence		
Urban	4,670	20.1
Rural	18,599	79.9
Region		
North	5,942	25.5
Centre	12,778	54.9
South	4,549	19.5
Sex		
Male	11,953	51.4
Female	11,316	48.6
Mother's age at childbirth		
<20	3,904	16.8
20-29	13,749	59.0
30-39	5,158	22.1
40+	458	2.0
Birth order		
1st order	5,440	23.4
2nd – 3rd order	8,417	36.2
4th – 5th order	5,122	22.0
6th and above	4,290	18.4

The variables included in the multivariate analysis are biological, demographic and socio-economic: the biological and demographic variables include sex of the child, age of mother at birth and birth order, and the socio-economic variables include urban or

rural place of residence, region, maternal education, paternal education, maternal occupation and paternal occupation. The important point in the multivariate analysis using this method is that the results are to be considered in relation to the combination of baseline categories. Baseline categories used are the first category of covariates in Table 7. 1.

7. 4. Results of the multivariate analysis

Table 7. 2. gives the relative risks in the univariate model, the multivariate model with all covariates (Model I) and the final model dropping non-significant covariates (Model II). The probabilities or *p-values* of the *Wald* test statistic show the level of significance of covariates and their categories. As in earlier chapters, $p < 0.05$ means

ans highly significant, and p <

significant. The strength of the effects of each covariate can also be seen from the differences of the smallest or largest values from 1. The following discussion of the relative risks in the multivariate analysis always refers to Model II. Model II is the final model which does not include mother's occupation and region, as they are proved in Model I to be not significant. Judging from the values of the relative risk, there are only very slight changes in these values for covariates which are maintained in Model II, a clear indication that mother's occupation and region do not play any part in explaining variations in infant and child mortality.

Table 7.2. demonstrates that in the univariate model, only region is not a significant determinant of infant and child mortality. When all covariates are considered in the multivariate analysis, maternal occupation is not significant either.

With respect to parental education, maternal education is a very highly significant determinant of mortality in both the univariate and multivariate analyses. When other factors are controlled for, the effects of maternal education becomes attenuated. The

mortality risk for children born to mothers having primary and above primary education is lower than for those with mothers with no education. Mortality for children born to mothers with above primary education is 43 per cent lower than for those born to mothers with no education.

In the univariate analysis, paternal education is also a very highly significant determinant of infant and child mortality. In the multivariate analysis, however, the difference in mortality between fathers having primary education and those with no education is not statistically significant. Only the effect of fathers with above primary education remains very highly significant. This is likely to be the result of the presence of father's occupation in the model. Paternal education is also a proxy for social status and

ects of which are likely to be cap

Fathers with only primary education are not likely to engage in economic activities that yield an income or economic return that is markedly greater than those with no education. Mortality of children born to fathers having above primary education is 26 per cent lower than for those born to fathers with no education. The effects on infant and child mortality of paternal education are markedly smaller than the effects of maternal education.

In the univariate analysis, mother's occupation is very highly significant. When other factors are examined spontaneously in the multivariate analysis, mother's occupation is statistically not a determinant of mortality, confirming findings by Hobcraft et al. (1984) and United Nations (1985) for many other developing nations that mother's occupation is not statistically important in explaining mortality when other factors are controlled for. The reasons for this outcome are already discussed in Chapter 6, where it

Table 7. 2. Relative risks of infant and child death and *Wald* test probabilities, FBSS 1994, Lao PDR.

Variables	Univariate		Multivariate Model I		Multivariate Model II	
	Relative risk (h/h0)	*P-value*	Relative risk (h/h0)	*P-value*	Relative risk (h/h_0)	*P-value*
Maternal education		**0.0000**		**0.0000**		**0.0000**
None	1.00		1.00		1.00	
Primary	0.68	0.0000	0.76	0.0000	0.76	0.0000
Above primary	0.40	0.0000	0.57	0.0000	0.57	0.0000
Paternal education		**0.0000**		**0.0000**		**0.0000**
None	1.00	0.0000	1.00		1.00	
Primary	0.84	0.0000	0.95	0.1789	0.95	0.1734
Above primary	0.50	0.0000	0.74	0.0000	0.74	0.0000
Mother's occupation		**0.0000**		**0.8115**		**0.8177**
Farmers	1.00		1.00		1.00	
Public servants	0.45	0.0000	1.08	0.5850	1.08	0.5779
Trade and others	0.73	0.0000	1.02	0.6700	1.02	0.6976
Father's occupation		**0.0000**		**0.0051**		**0.0000**
	1.00		1.00			
Labourers	0.54	0.0000	0.81	0.0094	0.81	0.0094
Public servants	0.48	0.0000	0.80	0.0033	0.80	0.0035
Trade and other professionals	0.70	0.0000	0.94	0.4591	0.94	0.4558
Urban-rural residence		**0.0000**		**0.0000**		**0.0000**
Rural	1.00		1.00		1.00	
Urban	0.50	0.0000	0.72	0.0000	0.72	0.0000
Region		**0.0968**		**0.6106**		**- - -**
North	1.00		1.00			- - -
Centre	0.93	0.0469	1.03	0.3430		- - -
South	0.92	0.0770	1.01	0.8108		- - -
Sex		**0.0006**		**0.0007**		
Male	1.00		1.00		1.00	
Female	0.90		0.90	0.0007	0.90	0.0009
Mother's age at childbirth		**0.0000**		**0.0000**		**0.0000**
<20	1.00		1.00		1.00	
20-29	0.69	0.0000	0.67	0.0000	0.66	0.0000
30-39	0.60	0.0000	0.45	0.0000	0.46	0.0000
40+	0.64	0.0000	0.42	0.0000	0.41	0.0000
Birth order		**0.0023**		**0.0000**		**0.0000**
1st order	1.00		1.00		1.00	
2nd – 3rd order	0.87	0.0008	1.01	0.8193	1.01	0.7985
4th – 5th order	0.90	0.0143	1.14	0.0102	1.14	0.0087
6th and above	0.98	0.6186	1.40	0.0000	1.40	0.0000

Source : Cox regression analysis, FBSS, 1994.
Note: - - - not in the model

has been shown that differentials by mother's occupation are not significant among women with above primary education. The univariate differentials in mortality by mother's occupation could be accounted for by other socio-economic factors such as urban or rural place of residence. In the univariate analysis, it can be seen that children of women who are public servants have the lowest level of mortality. Public service jobs are mainly located in the urban areas. It is normally the case that only traders in cities and towns can earn cash incomes many times more than those in other occupations. In addition, other employment opportunities for females are essentially found only in urban

In the univariate model, the effects of father's occupation are very highly significant, both for the variable overall and for each category. When other variables are present in the multivariate analysis, father's occupation also maintains its explanatory power in the mortality variations. In the multivariate model, however, the effects of individual categories of father's occupation become smaller relative to the effects shown in the univariate analysis. Mortality among children whose fathers engage in trade and other professional jobs are not statistically significant from that of those whose fathers are farmers. As mentioned in section 6.5. of Chapter 6, the category of 'trade and other professionals' in father's occupation covers a wide range of activities ranging from executives of private firms, wholesale and retail traders, street vendors, technicians and craftsmen in large cities and urban areas, to retail traders, those engaged in petty trade and grocery sale in house porches and craftsmen in rural villages.

When other factors are considered, children whose fathers are traders and other professionals experience the same level of mortality as those whose fathers are farmers,

probably because of the effects of paternal education. The bivariate analysis in Chapter 6 demonstrates that when paternal education is controlled for, infant mortality is highest for fathers with no education and engaged in trade and other professionals. In addition, the economic returns from these jobs may not be large enough to make their family living standards significantly different from those of farmers. Nutritional status among children whose fathers engage in trade and other professionals in the rural areas is probably not as good as among farmers' children.

Urban or rural residence is consistently a highly significant predictor of mortality in both the univariate analysis and multivariate analysis, but its effects becomes attenuated in the multivariate model. The risk of dying for infants and children living in

ent lower than the risk of dying i

confirms the effect on mortality of the gap in access to services between urban and rural areas, and of the disparity in living conditions whereby poverty and low levels of education are concentrated in the rural areas (World Bank, 1995b). However, due to the limitations of data, which do not include community variables on the access to health and other services, it not possible to fully assess the differential effects of these services on mortality by place of residence.

It could be that differentials in mortality between urban and rural residence do not solely result from the gap in the services or from the higher status of the urban population as claimed by other researchers (Trussell and Hammerslough, 1983; Hobcraft et al., 1984), but from many other environmental, cultural and behavioural factors for which no data are available for inclusion in this analysis. It is normally true that housing conditions and clothing in urban areas are more amenable to survival, and it is also reported that the lack of sanitation and potable water is still common in rural Laos (UNICEF, 1992; MCHI, 1994; NSC/LWU, 1995). It is observed that beliefs and

concepts with respect to disease, health care, hygiene, food handling and food preparation, which are directly linked to culture and religion, are markedly different between urban and rural residents (Breakey and Vougalopoulos, 1976; Maroczy, 1986, UNICEF, 1992).

In both the univariate and multivariate analyses, region is not a good predictor of mortality in Laos. Infant and child mortality differentials between the three regions of the country are not statistically significant in either model.

Sex is another covariate for which the effects on mortality remain unchanged from univariate to multivariate analysis and they are highly significant. Female mortality is 10 per cent lower than male in both models.

Mother's age at childbirth is a strong determinant of infant and child mortality. Its effects remain very highly significant in both the univariate analysis and multivariate analysis. The direction of its influence on mortality changes from that of a reverse-J-shaped pattern in the univariate analysis to one in the multivariate analysis in which mortality continuously decreases with mother's age.

Similar patterns to those found in the multivariate analysis are also observed for the Philippines and Indonesia (Martin et al., 1983) and for Sri Lanka (Trussell and Hammerslough, 1983). In relation to children born to mothers aged less than 20 years old, the risks of mortality for children born to mothers in other age groups are 34, 54 and 59 per cent lower for children of mothers aged 20-29, 30-39 and 40 years old or more, respectively.

In the univariate analysis, the effects of birth order are highly significant, but they are more so in the multivariate analysis, though the difference between first birth order and second or third birth order is not significant. In the univariate model, the mortality risk according to birth order displays a U-shaped pattern, but in the multivariate model

the mortality risk increases with birth order. Relative to children of first birth order, for children of fourth and fifth birth order and of sixth birth order and above, the risk of dying is 14 and 40 per cent higher respectively, while children of second and third birth order have the same risk as those of first birth order.

This obviously depicts the negative effects of competition for limited family resources and care among children in large families. The high mortality risk among high order births also results from high fertility, especially among rural women who live in poverty and are exposed to excessive labour in farming, inadequate nutrition and frequent child bearing resulting in maternal depletion syndrome (Winikoff and Castle, 1987) which in turn leads to the incidence of low birth weight, among other problems, and hence high mortality risk (Hobcraft et al., 1983).

Compared to the univariate analysis, the effects of both mother's age at childbirth and in particular birth order are stronger in the multivariate model. In other studies, the effects of mother's age at childbirth and birth order on mortality have also been found to be increased as other socio-economic variables are added to the model (Martin et al.,1983).

7. 5. Summary

In sum, it is apparent that when other variables are present, the effects of all covariates in the multivariate model change, except sex of the child. The effects become attenuated in the cases of maternal education, paternal education, father's occupation and urban or rural residence. The effects of mother's age at childbirth and birth order increase in the multivariate model, and mortality differentials also change their directions.

The relative risks in the final multivariate model show that among the demographic variables, mother's age at childbirth is the strongest determinant of infant and child mortality, followed by birth order with sex being the weakest demographic

determinant of mortality. Sex of the child probably accounts only for mortality differentials by biological make-up of the sexes, as in general there is no evidence of sex preference in Lao society (Maroczy, 1986; UNICEF, 1992; Phimmasone et al., 1994). Of the socio-economic variables examined, maternal education is the strongest determinant of infant and child mortality, while urban or rural residence comes second, followed by paternal education. Father's occupation is the least important among them, but its effects on mortality differentials are still large.

It is important to note that the effects of income and social status as captured by husband's occupation and education are not as important as the effects of mother's education in determining mortality. Another important determinant of mortality is urban or rural residence, even when other factors are controlled for, reflecting the disparity in the availability of and access to sanitation and services, particularly immunization and maternal and child health care, and differentials in environmental, cultural and behavioural factors. Chapter 8 attempts to elucidate possible causes and explanations for the observed mortality levels and differentials across socio-economic groups. Lastly, for a better understanding of the determinants of child survival in the Lao context, further research is needed into areas such as feeding behaviour, including food preparation, handling and preservation, health beliefs and the utilization of health services, and the links between health and mortality and the changing economic conditions, particularly increasing costs of health care and medicines and food prices in the face of structural adjustment and regional crisis.

Chapter 8

Discussion and policy implications

8.1 Introduction

Once mortality levels and differentials as well as their determinants in Lao PDR are established, the next questions that need to be investigated are concerned with the broader context of these results. The levels of mortality in a particular population and patterns of mortality differentials observed across various populations are mainly determined by various factors; biological-demographic, socio-economic, environmental, political and institutional, and cultural and behavioural. Such factors manifest themselves differently in populations at different stages and levels of development (Ruzicka and Kane, 1990).

Past European experience indicates that improvement in mortality was brought about by economic development and increased living standards, advances in medical science and most particularly improvements in sanitation and nutrition (McKeown et al., 1975; McKeown, 1976). Meanwhile it is generally accepted that improvement in mortality in developing countries particularly following World War II, is achieved at a relatively faster pace mainly due to the importation, diffusion and adoption of modern health services (Stolnitz, 1965; Arriaga and Davis, 1969; Caldwell, 1986; Ruzicka and Kane, 1990; Palloni, 1990). Mortality reduction can be realized rapidly through access to vaccines and other modern medicines at relatively low economic cost and not necessarily always through socio-economic progress, therefore weakening the relationship between mortality and level of wellbeing (Preston, 1975; UN, 1982; ShuiMeng, 1986; Palloni, 1990). When causes of deaths are examined for Latin American countries, Palloni (1990: 200) also questions the role played by exogenous medical intervention because some diseases, such as respiratory diseases and diarrhoea

are resistant to medical treatment and therapeutic measures are expensive and beyond the reach of the underprivileged and the poor. Deaths caused by these diseases can be prevented by increased resistance through better nutrition and antenatal and postnatal care, improved clean water supply and sanitation. Hence, improvements in living standards of the population still hold a crucial place in mortality reduction.

There is a tendency for mortality convergence between developed and developing countries (UN, 1982; US Census Bureau, 1994) and also among countries in developing world (ShuiMeng, 1986). This mortality convergence, however, can be observed only for general mortality rates, not for infant and child. Influences upon the latter are largely determined by biological and demographic factors, and by the of the household and community resources (Ruzicka and Kane, 1990), which in turn are essentially determined by the levels of social and economic development (UN, 1982; Palloni, 1990). Therefore, differences in levels of socio-economic development persistently produce mortality differentials between countries within regions and between population subgroups within a country (UN, 1982, 1985; Hobcraft et al., 1984; Pebley and Hill, 1986; Palloni, 1990), and such differentials are also observed to exist among countries in Southeast Asia (Ruzicka and Hansluwka, 1982; ShuiMeng, 1986).

One purpose of this chapter is to compare mortality in Lao PDR to the experience of other Asian countries and in particular to some countries belonging to the Association of Southeast Asian Nations (ASEAN). To avoid the problem of comparisons being affected by differences in age structure, the discussion uses mortality indices that are independent of this structure: life expectancy at birth and the infant mortality rate.

A second aim of this chapter is to examine the contextual forces influencing the mortality differentials observed between Lao PDR and its neighbouring countries and

within Lao PDR itself. This might provide additional insight into factors affecting mortality beyond the explanations considered in earlier chapters of this thesis. The initial discussion below reviews the findings on Lao mortality from the preceding chapters.

8. 2. Findings on mortality in Lao PDR

This study has for the first time produced age-specific mortality rates and life tables for Lao PDR using data from the Multi-round Vital Statistics Survey (MVSS), for adult mortality, and from the Fertility and Birth Spacing Survey, for infant and child mortality. Adult mortality estimates can be said to be free of problems of under or over reporting of population and under reporting of deaths as population and death data are from the same source. The estimates are net of the effects of migration and, as a result, estimates of adult mortality might be a little optimistic as they capture only the mortality experience of non-migrant population. The analysis of infant and child mortality levels and differentials used life table techniques. Determinants of infant and child mortality were analyzed using the Cox regression model, a multivariate life table procedure which is a robust technique for dealing with time-interval variables. Many covariates of infant and child mortality can be entered into the model simultaneously.

Adult mortality differentials can be clearly identified at ages under 40 years old. At ages 40 and over, mortality differentials are less pronounced. Mortality differentials were mainly found among population subgroups with different degrees of socio-economic development, different types of ecological and agricultural production systems, different access to health and other social services and different cultural backgrounds. Mortality is higher in regions away from the centre, higher in the Highland zone than in the Lowland zone, and also higher in rural areas than urban areas. Mortality is higher for people of ethnic groups other than the Laoloum.

Classification of population by regions reflects the differences in the levels of socio-economic development between the three regions of the country. Classification by agro-ecological zones distinguishes between types of residence by altitude, modes of agricultural production and livelihood in general, and difficulties in transportation and access to health and other services. Likewise, classification by urban or rural residence gives a picture of disparity in the availability of services and living standards existing between urban dwellers and the majority of population living in the countryside. Lastly, ethnic group classification reveals differences in traditional beliefs and cultural practices with respect to health care, food habits, hygiene and sanitation.

The whole mortality schedule is heavily weighted by the very high level of infant and child mortality. An infant mortality rate of 125 infant deaths per thousand live births for Lao PDR is considered very high by present day world and Asian standards. There are altogether 37 countries in the world where infant mortality exceeds 100; six countries of these are located in Asia: Afghanistan, Bangladesh, Bhutan, Cambodia, Pakistan and Lao PDR (US Census Bureau, 1994: 33, A-28).

There is evidence of significant decline in infant and child mortality, particularly during the period from 1975-79 to 1985-89. The trend in the subsequent period is not significantly different from the 1985-89 period, a finding consistent with that the Ministry of Health's conclusion based on a different survey that there has been almost no declining trend in infant mortality during the last ten years (MCHI, 1994).

Significant infant and child mortality differentials exist across different characteristics of the population under study. There are strong infant and child mortality variations by biological variables such as age of mother's age at birth, sex of the child and birth order. Infant mortality by mother's age at birth displays the expected U-shaped pattern, with high infant mortality for mothers who are below 20 years or 40

years and above. This pattern is not evident in the case of child mortality; child mortality continuously decreases with mother's age. In the univariate analysis, infant mortality by birth order also displays a U-shaped pattern while child mortality continuously increases with birth order. However, in the multivariate analysis, infant mortality also increases with birth order when other factors are controlled for, probably reflecting the importance of other socio-economic variables such as place of residence and education. People with a higher level of education usually live in urban areas and have a smaller number of children, and infant and child mortality among these people is the lowest. Infant mortality rate for females is significantly lower than for males, while child mortality for both genders is about the same.

There appear to be no significant infant mortality differentials among the three regions of the country. This is the case in the multivariate analysis when other factors are controlled for. However, in the univariate analysis in which Savannakhet was examined separately from the centre, infant and child mortality in the centre is found to be significantly lower than elsewhere, probably reflecting the higher level of development and the concentration of health and educational facilities in the centre. Child mortality in the north is found to be higher than elsewhere. The north is largely mountainous and less developed than other regions.

Infant and child mortality in the rural population is substantially higher than that in the urban population. Rural infant mortality rate is almost double that for urban areas. The urban-rural differentials persist even when other socio-economic factors are taken into account.

Maternal education is an indicator of social status and knowledge of health care and likelihood of making use of health services. Maternal education especially is found to be a strong determinant of infant and child mortality, particularly in rural areas.

Infant and child mortality is highest among children born to a father or a mother without schooling, and it shows a decreasing pattern as education of parents increases.

Parental occupation, an indicator of family wellbeing or resources available to the household, is an important precursor of infant and child mortality. Even though mortality differentials by mother's occupation are statistically significant in univariate analysis, they are not so in the multivariate analysis. This may be partly because of the economic returns to women engaging in economic activities is often offset by deleterious effects of not having adequate time for infant and child care (UN, 1985). In such a situation in Lao society, an inexperienced older sister or a grandmother becomes substitute caretaker. It may also be partly because of the vague classification of occupation itself. Father's occupation, on the other hand, strongly influences infant and child mortality even when factors such urban or rural place of residence and education are controlled for. This accords with the pattern generally expected in Lao society that father must be the prime supporter of the family. Infant and child mortality of children born to a parent engaged in agricultural activities is the highest while those born to a parent who is a public servant is the lowest. This does not reflect differences in income between farmers and public servants, as public servant salaries in Lao PDR are well below subsistence level and not paid regularly, aside from rice and meat rations. It rather portrays differences in levels of knowledge of and access to health care and occupational exposure to modern hygienic and health practices that benefit child survival.

Evidence on infant and child mortality also comes from another study (MCHI, 1994), which finds differentials between the poor and the non-poor, and between Laoloum and the Other Lao. The infant mortality rate for the poor is 148 per 1000 live births as compared to a rate of 82 for the non-poor. The infant mortality rate for

Laoloum is 115 per 1000 live births as opposed to 147 for the Other Lao, about the same as the poor.

8.3. Lao PDR in comparative perspective

As indicated in Table 8.1, mortality and socio-economic conditions in Lao PDR, and of course in Cambodia as well, are among the worst in South East Asia. These two countries have the region's highest infant mortality and lowest life expectancy at birth. Per capita gross national product (GNP) was also among the poorest in the group under investigation, just a little better than Cambodia and Vietnam. It is evident from Table 8.1 that countries with low infant mortality also have small proportion of illiterate population, especially females. The illiteracy rate for Lao females is the highest. Lao PDR was ranked in 1990 by the World Bank as the tenth poorest nation on earth. Even though, the true level of infant mortality in most of developing countries (Cleland et al., 1992: 5), cannot be known with certainty, it is clear that in almost all of the countries in the South East Asia region mortality transition has been in progress since the 1950s or so (Ruzicka and Kane, 1987). Only Cambodia is left in the same mortality situation as Lao PDR. The infant mortality level in Lao PDR is similar to many African countries like Chad, Ethiopia, Liberia, Mauritania and Senegal, with their levels of IMR in 1988 of 130, 135, 130, 125 and 126 per 1000 live births respectively (World Bank, 1990: 228).

Data in Table 8.1 reveal a similar picture to the one presented in a study by Caldwell (1986). In this study Caldwell examines how outliers like China and Vietnam, despite their relatively low income per capita, have nevertheless achieved low mortality. Their example shows that low income alone is not a sufficient explanation of the poor mortality performance of Lao PDR.

Table 8.1. Estimates of the infant mortality rates (IMR) and life expectancy at birth, e(o), for 1994 and selected socio-economic indicators for selected countries in Asia.

Country	IMR	E(0)	GNP per capita (1996) US $	Adult illiteracy rate (1995) (% of people aged 15 and above)		Access to safe water (% of population) (1995)
				Males	Females	
Lao PDR	125[1]	50[1]	400	31	56	39
Cambodia	111	49	300	20	47	13
China	52	68	750	10	27	90
Indonesia	67	61	1080	10	22	62
Malaysia	26	69	4370	11	22	88
Myanmar	64	60	433[3]	11	22	38
Philippines	51	65	1160	5	6	86[4]
Thailand	37	68	2960	4	8	81
Vietnam	46	65	290	4	9	36
Asia	68	63				
Sub Saharan Africa	95	51				
Latin America and the Caribbean	43	68				
Europe	9	76				
North America	8	76				

Source: Except for Lao PDR, estimates of IMR and e(0) for other countries are taken from ' World population profile 1994', Report WP/94, Table 8, page A-27 and A-28, U.S. Bureau of Census.
Data on GNP, illiteracy and access to safe water are extracted from ' World development indicators', Table 1.1, page 12, and Table 1.2, page 18, World Bank, 1998
[1] Figures of IMR and e(0) for Lao PDR is estimated from the FBSS, 1994.
[2] The GNP figure for Myanmar is extracted from the Economic and Social Commission for Asia and the Pacifics (ESCAP) Internet Home page, Asia and the Pacifics in Figures 1997.
[3] The figure on access to safe water for the Philippines is extracted from Table 2, page 5. 'Demographie de la peninsule Indochinoise', by Gendreau, Francis, Fauveau, Vincent and Thu, Dang (1997), Paris: University of Francophone.

Although there is cross-country evidence that the relationship between the level of economic development or wellbeing as measured by gross domestic product (GDP) or per capita income GNP and mortality has weakened over time, much of the overall change in mortality can be explained by change in per capita GNP (Preston, 1975; UN, 1982). It is expected that the relationship between per capita GNP and infant mortality is stronger than that found between per capita GNP and life expectancy (UN, 1982: 38). Also, the relationship between per capita GNP and life expectancy weakens partly

because affluence tends to be associated with certain deleterious behaviours such as overnutrition, heavy smoking and drinking, and stress, among the adult population. Hence, further gains in longevity when life expectancy is already high become much more difficult to achieve (UN, 1982: 39-40).

In contrast, Palloni (1990:202) has argued that infant mortality may be sensitive to many aspects of political and social development which are poorly captured by a measure such as per capita income (Palloni, 1990). Nevertheless, level of wellbeing is still demonstrated to play an important role in mortality reduction (Preston, 1975, UN, 1982) in addition to the expansion and adoption of modern medical technologies, which themselves depend also on the levels of socio-economic development. It is widely held that mortality improvement beyond a certain threshold cannot be achieved in the face limited progress in social and economic development (Gwatkin, 1970; Ruzicka and Hansluwka, 1982; Ruzicka, 1986; Ruzicka and Kane 1990). The relationship between the level of development and mortality is found to be non-linear, but where there is a high level of community development there is low mortality (Edmonston and Andes, 1983; Prasithrathsint et al., 1986; Peng and Bakar, 1986). Furthermore, it was estimated from the experience of developed countries that about 16 per cent of the increase in life expectancy between 1938 and 1963 was accounted for by the increase in national income, while the rest is due to factors exogenous to the level of income (Preston, 1975: 238).

It is therefore imperative to look at the underlying forces that are believed to influence the observed mortality and socio-economic differentials. These can better be examined in a broader political, social and economic context than through a mere snap shot like the measures of the economy presented above. The countries included in Table 8.1 can be divided into two distinctive groups. The first group consists of the non-

socialist countries including Malaysia, Indonesia, Philippines, Myanmar and Thailand where there exists an evident association between mortality levels and per capita GNP levels. The second group is the socialist countries including China and Vietnam where mortality levels are remarkably low despite their GNP. Cambodia needs not be taken into consideration explicitly as its mortality level and socio-economic development are not markedly different from the Lao situation. Moreover, it is marked by the experience of genocide under Polpot and subsequent political unrest.

In terms of political and administrative institutions the first group is as authoritarian as the second. The differences until very recently lie mainly in the pathways of pursuing economic development and the growth efficiency hence derived.

In the 1950s the countries included in Table 8.1. were essentially similar to other third world countries, with the Philippines perhaps better off than the others (Gendreau et al., 1997: 3). Mortality levels were approximately the same: over 1950-55 crude death rates per 1000 population ranged from 19 for Malaysia and Indonesia and 20 and 21 for China and Thailand respectively to 25 for Laos, Myanmar and Cambodia (ShuiMeng, 1986: 4). The crude death rate for the whole of Vietnam in the same period was not known exactly but it was 12 for North Vietnam in 1960 (Bryant, 1998: 15). Following the later half of the 1950s mortality in almost all countries discussed here started to experience a fast decline, with Malaysia, Thailand and the Philippines leading the way in the former group(ShuiMeng, 1986). The decline in Lao and perhaps Cambodian mortality, however, was very modest.

Mortality decline in the first group of countries is achieved through, in the terms of Caldwell (1986), both political and social will, while in the second group it was through political will. According to lessons drawn from the experience of Sri Lanka, Kerala and Costa Rica. Caldwell (1986: 208) concludes that factors required to attain

low mortality are female autonomy; adequate financing of modern or Western health services and education with health services accessible to all; provision of a nutritional floor or equitable distribution; universal immunization and antenatal and post natal care by fully trained personnel.

Mortality decline in Malaysia, Thailand, the Philippines and Indonesia is attributable to the improvement in socio-economic conditions of the population and the extensive expansion of primary health and sanitation facilities, and especially the increase in the number of trained mid-wives and medical doctors. Equally important has been the increase in educational services particularly to females (Peng and Abu Bakar, 1986; Prasithrathsint et al., 1986; Knodel et al., 1987; Soeradji and Ismail, 1986; Alvarez, 1986). Improvement in nutritional standards is also a contributing factor to mortality decline in these countries (Ruzicka and Hansluwka, 1982). However, the relative importance of the various actors responsible for mortality decline in the first group of countries is also far from uniform.

In the Philippines, the dramatic decline in mortality is said to be the result of the effective eradication of malaria and other types of infectious diseases through the expansion of health and sanitation facilities, while the effects of socio-economic factors are felt much later in further reducing mortality (Alvarez, 1986: 199). Mortality decline in Indonesia and in Thailand is more attributable to improvement in socio-economic conditions. Such conditions are also linked to better nutritional status in the population, which in the case of Indonesia is more important in determining infant mortality than maternal, health and health facility variables (Soeradji and Ismail, 1986: 94). In Thailand, the effects of social and economic development on mortality is far greater than the effect of the improvement in the health delivery system (Prasithrathsint et al., 1986: 290). Improvement in the standard of living and health care services - particularly

the control of communicable diseases, better water supply, nutrition and sanitation - are credited for the decline in mortality in Malaysia (Peng and Abu Bakar, 1986). The increase in maternal education and improvements in water and sanitation are the most important changes at the household level that accompany regional and temporal development in Malaysia (Davanzo, 1988). Mortality decline in China and Vietnam owes much to the mass campaign in primary health care facilitated by strong political institutions, which may not be good for mobilizing resources for economic growth but are very efficient for promotion of health service delivery. Other factors in the mortality decline were the expansion of education and improvement of women's position both of which are central goals of the socialist ideology (Caldwell, 1986; Bryant, 1998).

Why then has Lao PDR achieved low mortality levels seen in the other countries? As the discussion above has shown both economic and social development and political and administrative institutions committed to that development are needed for mortality decline. Differences in economic conditions conducive to lowering mortality between Lao PDR and other countries during recent years are very stark. While countries in the first group have enjoyed peaceful and economic growth, Laos was heavily engaged in war until 1975. That year marked the start of the country's rehabilitation. It was not until 1989 the Lao economy has experienced any growth (World Bank, 1994). The economy of Laos in the Royalist zone prior to the foundation of Lao PDR was largely supported by the United States, much less was known about the economy of the Pathet Lao zone except that military and food aid was mainly from Soviet Union, China and Vietnam (Fox, 1982; Sisaliao et al. 1989).

In terms of the two groups of countries identified above, both forms of economy prevailed in Lao PDR. It is a subsistence economy more than a capitalist or a socialist economy. Up to 1990 more than half of the Lao economy was not monetized (UNDP,

1991). In fact a socialist type economy like the ones realized in China and Vietnam has never been existed in Lao PDR, except for the control of prices and the nationalization of banking and some enterprises, which hardly affected the majority of people who rarely use products from these enterprises and for whom parallel markets existed all along. The majority of the Lao economy is agriculture (NSC, 1995a), in which the process of collectivization never proceeded far (World Bank, 1994, 1995a). It was attempted in late 1970s and early 1980s but abandoned due to the resistance met from the population, who either destroyed crops, abandoned production or fled to Thailand. Price controls, until 1986 when it was liberalized, also covered only essential goods such rice, cash crops and fuel. These commodities were traded by the state sector and supplied to officials and the army, but prices used in transactions among the general population were those of the free markets.

Economic growth in Lao PDR was estimated at 14 per cent in 1989 and to have averaged 6 per cent per year (at constant prices) in the early 1990s (World Bank, 1994: 127). Elsewhere in the region economic growth was quite remarkable. Over 1965-85 it ranged from 1.2 per cent for the Philippines to about 4 per cent for Thailand, Malaysia and Indonesia, and 5.4 per cent for China (World Bank, 1990: 178).

As agriculture accounted for 61 per cent of GDP in 1990 and 56 per cent in 1994 (NSC, 1995a: 130) and as use of modern input and technology in the agricultural production is low, the Lao economy can be said to be weather-dependent. Industrial and service sectors have increased in size since early the 1990s but remain quite underdeveloped. The major constraint in economic and social development is the poorly developed road and transport networks: presently about half of the country is not accessible by road during the rainy season (UNDP, 1991; World Bank, 1995b).

To some extent Vietnam possesses similar disadvantages and it was perhaps more heavily affected by the Vietnam War. Vietnam's infant mortality rate, however, is much better than that of Lao PDR- one third of the Lao level. A probable explanation for this gap would be the higher level of education in Vietnam, particularly of women, and Vietnam's extensive health care networks and more developed transport and communication systems.

In addition, viewed from a political history perspective, relative to other countries Lao PDR is least exposed to Westernization, especially in the areas of health and education. Experience from the American continent shows that different colonial cultures lead to differences in mortality levels and patterns among population being colonized (Kunitz, 1990: 96-97). For instance, mortality in the Anglo American societies is generally lower than that in Latin American countries. Even the pattern of Canadian mortality is different from that of the United States, due to different cultural heritages (Kunitz, 1990:97). All the countries listed in Table 8.1 came into contact with western cultures during the colonial era and in the process ideas about modern health care and education were likely to have been transferred to their populations. During the period of French rule, Laos was seen as an outpost and the very difficult nature of its terrain, as compared to other French colonies, impeded the development of health and educational systems. Those that existed were meant to serve just the ruling class employed by the French, while important positions in the public service were staffed by Vietnamese in whom French had more confidence than Lao nationals (Sisaliao et al., 1989). The majority of the population was therefore not exposed to westernized civilization, and Laos remained in isolation until it was pulled into the turbulence of World War II (Gendreau et al., 1997). For most of the time until the present day only people living in towns or suburban areas have come into contact with or even seen

western foreigners. Therefore, only the urban and suburban population is affected by westernized ideas of hygiene, health care and education.

In addition to the growth in the economy, political and administrative institutional infrastructures can also be drawn on in meeting making mortality goals, as they are, for example, in fertility control in Indonesia and China (McNicoll, 1994) and to some extent in Vietnam (Bryant, 1998). Although Lao PDR is also ruled by one party - the Lao People's Revolutionary Party - which has a strong presence in each and every village in the country as in China and Vietnam, the existing administrative and political institutions at the grass root level are mostly used for different purposes: for consolidating the party's power and for maintaining political and social security, and for mobilizing the population to be watchful against the subversive actions of the "counter-revolutionary elements". Unlike in Vietnam and China where involvement of the community in the health care is strong (Caldwell, 1986; Bryant, 1998), in Lao PDR health care delivery, most of it based on therapeutic measures, is usually assumed to be solely the duty of the Ministry of Health and its line offices in the provinces and districts, and they are mostly weak in terms of financial and personnel resources.

As an adjunct to local meetings for political study, a mass campaign for three types of cleanliness (cleanliness in housing, cleanliness in clothing and cleanliness in eating) was launched but its purposes and potential benefits were never communicated to the general population. Without understanding its meaning, no tangible result was achieved. Through village meetings, villagers were also asked to sleep under mosquito nets and drink boiled water, not to keep livestock beneath the house at night, and to give up superstitious beliefs about cause of disease (belief especially prevalent among the ethnic minorities). Except for government employees whose level of education is higher than the general population, few of villagers follow these instructions. Furthermore, due

to cultural practices of the ethnic minorities and the language barrier, the last instruction about superstition sometimes offended audiences among the ethnic tribes. Economic and political entities such as communes in China and Vietnam have health care units funded mostly by local authorities or by the communes themselves (Caldwell, 1986; Bryant, 1998). In Lao PDR these kind of health care units existed only in government headquarters and in public enterprises. In Vietnam, thousands of health workers, often recruited among local people, are trained and sent back to their localities to promote use of mosquito nets, to administer local drugs and vaccination, and to perform baby delivery and other basic functions of primary health care (Bryant, 1998: 246). There is no such scheme in Lao PDR.

Summarizing to this point, the important forces underlying the high levels of mortality in Lao PDR relative to other countries in the regions include the highly underdeveloped economy which did not experience growth until the end of 1980s; the political and administrative institutions which are weak in resources and personnel quality and which are not especially concerned with promoting health care and lowering mortality; and the poorly developed infrastructure.

Low levels of social and economic development means widespread poverty. As the Lao economy is weather-dependent and little modern inputs and technology are used, productivity is low (World Bank, 1995a) which in turn generates poverty, particularly among rural farmers (NSC, 1995b; World Bank, 1995b). Technological backwardness is obviously one cause of poverty. The main reason why poor countries and many individuals in them are poor is that they apply far less efficient production technologies in most of their economic activities than in the cases of rich countries (Norbye, 1983:16).

Poverty is a matter of deprivation, and the ability of a person to command any commodity that that person wishes to acquire or retain depends on the entitlement relations that govern possession and use in that society, and it depends on what that person owns, what exchange possibilities are offered, what is given free and what is taken away (Sen, 1981:154-155). Robert McNamara, when he was president of the World Bank, has summed up absolute poverty as "a condition of life so characterized by malnutrition, illiteracy, disease, squalid surrounding, high infant mortality and low expectancy of life as to be beneath any reasonable definition of human decency" (cited in Peter Singer, 1993). More simply, poverty can be broadly defined as the inability to achieve a minimal standard of living (World Bank, 1990). The World Bank places its 'poverty line' at an annual income of US $370 (World Bank, 1990).

Poverty is found to be related to mortality (UN, 1982; Ruzicka and Kane, 1983), especially in an agrarian society (Millards et al., 1990). Moreover, there is a strong association between malnutrition and an inadequate diet and morbidity among children. Chronic protein-energy malnutrition leads to stunted growth, and increased morbidity and mortality among children in the developing world (Jelliffe and Jelliffe, 1989), and childhood malnutrition also decreases the survival chances of adults later in life (Mosley and Gray, 1993).

Overall, the poverty incidence rate in Lao PDR is 46 per cent for 1992. The Lao poverty incidence is comparable with the average rate for Sub-Saharan Africa (47 per cent), and slightly lower than that of South Asia (51 per cent) in 1985 (World Bank, 1990: 139). This overall rate of poverty incidence for Lao PDR conceals the disparity existing among population subgroups. The poverty incidence rate for the rural population is 53 per cent. Regionally, the south experiences the highest poverty rate, 60 per cent, followed by the north, 46 per cent, and the centre, 40 per cent (World Bank,

1995b: 13). Farmers are usually among the poorest occupational groups: the poverty incidence for farmers is 52 per cent (World Bank, 1995b: 105). Due to their relative disadvantages in terms of education and skills and types of production, poverty among the Other Lao is higher than for the Laoloum (Gendreau et al., 1997). A study found that, in early 1990s, the proportion of population considered as non-poor was 43 per cent for the Laoloum and only 9 per cent for the Other Lao (Phimmasone et al., 1994). Poverty in Laos is also found to be strongly correlated with education: 57 per cent for population with no education and only 15 per cent with for population with higher secondary school education (World Bank, 1995: 11).

It is therefore not surprising to find from this study that infant and child mortality is relatively high in regions other than the centre (excluding Savannakhet), in rural areas, among children of mothers with no education and mothers engaged in farming activities. Adult mortality is also higher in the north and the south, in rural areas, in the Highland zone and among population groups other than Laoloum.

Factors believed to be responsible for the persistent high level of mortality in Lao PDR can be examined further, some of them in relation to Caldwell's proposed conditions conducive to low mortality mentioned above. Table 8.2 presents some social and health indicators for Lao PDR and other countries in the region.

8. 4. Food supply and nutrition

Decline in mortality can be brought about by improvement in nutritional status in the population (McKeown, 1976; Ruzicka and Kane, 1990; Scholfield, 1991). Nutritional level in a subsistence economy like Lao PDR, where transport infrastructure and agricultural markets are poorly developed (World Bank, 1995a; 1994), is mostly influenced by food production and availability, and to lesser extent by marketing. Malnutrition is known to be one of the main causes of under-five mortality in poor

countries (Puffer and Serrano, 1973). In Lao PDR, as elsewhere, it is linked with poverty and limited and unstable food production (UNICEF, 1992: 162; Somsanit et al, 1995).

Table 8.2. Selected nutritional and health indicators for Lao PDR and selected Asian countries.

Country	Daily calorie Consumption Kcal/day/capita 1990	Population per physician 1984	Total fertility rate 1987-89	Babies with low birth weight 1985 (%)
Lao PDR[1]	2232	1236	6.4	39
Cambodia	2114	...	5.8	...
China	2703	1000	1.8	6
Indonesia	2631	9460	2.8	14
Malaysia	2697	1930	3.5	9
Myanmar	2445	3740	3.6	16
Philippines	2452	6700	3.4	18
Thailand	2271	6290	2.1	12
Vietnam	2215	1000	3.3	18

Source: [1] Calorie intake figure extracted from " Food security at national and household levels, its project and food preparedness" by Amalathithada et al., 1995, p. 28.
Number of population per physician derived from "Basic statistics about socio-economic development in the Lao PDR", Committee for Planning and Cooperation, National Statistical Centre, Table 110, p. 163.
Total fertility rare (TFR) for Lao PDR is taken from the FBSS , NSC/LWU, 1995, p. 25.
for other countries:
Data on calorie intakes are obtained from the ESCAP internet Home page, Asia and the Pacifics in Figures 1997.
Total fertility rare (TFR) obtained from the ' World population profile 1994, Report WP/94, Table 7, page A-22-A23, U.S. Bureau of Census.
Number of population per physician figures are extracted from 'World Development Report 1990: poverty', Table 28, page 232, World Bank, 1990.
Percentage of low birth weighted babies (including figure for Lao PDR) are except from 'World Development Report 1990: poverty', Table 28, page 232, World Bank, 1990.

In almost all discussion of food supply or food availability in the Lao context, it is inevitable to analyze the rice production situation, as rice is the main staple food, comprising 75 per cent of the total diet of the Lao people (Sisouphanthong, 1995). Table 8.2 shows that the daily calorie intake of the Lao people is among the lowest except for Vietnam and Cambodia.

Rice production in Lao PDR falls short from self sufficiency. The most affected groups are people living in the rural mountainous areas where rice production may cover household consumption only for about 4 or 5 months of the year (Amalathithada

et al., 1995). Agriculture production largely bases on rice, which occupies about 80 per cent of the land under crop production (NSC, 1995a). Little of the production is marketed reflecting the subsistence nature of the agrarian economy and its vulnerability to natural disasters such floods and droughts which are frequent occurrences (NSC, 1995b, World Bank, 1995a), sometimes both in the same year (Lao PDR, 1996; UNICEF, 1996). It is estimated that losses in natural calamities account for about twenty per cent of food production in the country (UNICEF, 1996: 134).

There are actually two different types of farming systems in Lao PDR, namely sedentary Lowland cultivation and slash and burn (shifting) cultivation, which use different amounts of labour and other inputs and give different yields for the same crop. Slash and burn cultivation (sometime called swidden cultivation or shifting cultivation , or locally, " *hai*") involves the clearing of bush and forest trees, sometimes primary forest, at the beginning of the dry season, around January or February. These are left to dry until about April before being burnt in order to release bio-mass and nutrient into the soil. The plots are then fenced and rice is planted, sometimes intercropped with other crops such beans, maize or other legumes. The growing period is longer than in the case of permanent paddy field farming.

This type of cultivation requires a great deal of human labour input as no draught animals are used. The yield is also relatively low. A man involved in cutting and clearing would need to stay away from home for this job, as the "*hai*" is often located quite far away from where people live. For planting, all household labour is required. Weeding is a time-intensive task mainly done by women.

Slash and burn cultivation is practiced on the hill slopes by people belonging to the Miao-Yao and Mon-Kmer linguistic families and on the mountain tops by the Sino-

Tibetian or Hmong people. A small proportion is practiced on flat land along the valleys by people of various Laoloum tribes such Tai-Dam, Lue and others. The land is abandoned after only one cropping (in some cases it is two or three years before it is left but the crop yield would certainly decrease) and left for a fallow period of normally seven to ten years, while farmers move on to clear another plot of land, eventually returning to the original plot. This means a family of five people would require at least seven to ten plots of land of about 1.5 hectares each in order to sustain their lives. Farmers who practice this method of farming are often worse off than those practicing permanent paddy field cultivation.

Slash and burn cultivation is very susceptible to drought, which as noted earlier occur almost every year in one or another area. Therefore shifting cultivators often suffer from chronic malnutrition or undernutrition resulting from a rice deficit (Maroczy, 1986, Amalathithada et al., 1995, ANUTECH, 1996).

Another form of farming practice, locally called "*na*", practiced in the Lowland plains and valleys, is sedentary rice farming. A small proportion of it irrigated, the rest is rainfed. In the western literature this system of farming is also referred to as " wet rice farming". It involves constructing permanent paddy field with chess- board-like squared dikes to confine water. Rice is transplanted in these fields after sowing in separate plots. Normally, it would take three to four months before rice could be harvested. Double-cropping is rare and practiced only where irrigation is available- in the central and southern plain bordering the Mekong basin.

Wet rice cultivation during rainy season starts as soon as the rains soften the soil, with farmers plowing the fields, normally using plows pulled by water buffaloes. The transplanting operation requires a lot of labour, involving all household members and sometimes outside labour through hiring or a labour exchange arrangement. Because of

the limited area amenable to double cropping, the food situation of the population living from wet rice farming, though better than the shifting cultivators, also depends on the weather conditions particularly in the flood prone areas.

Across regions of the country, as there are large variations in food production. The centre is where the bulk of food production takes place. With respect to rice production, the majority of the area for permanent wet rice fields rainfed or irrigated is located in the centre, with a small proportion in the south, while the areas for rice production in the north heavily rely on slash and burn cultivation along hill and mountain slopes. In 1990 it was reported that the yield of wet rice production was 2.76 tons per hectare as compared to the yield of slash and burn cultivation of only 1.44 tons per hectare (NSC, 1995a: pp. 33-41).

Most of the provinces in the north suffer from chronic rice shortage (World Bank, 1995a; NSC 1995a). Provinces in the central region are normally rice surplus producers. More than half of the total areas of lowland permanent rice farming are in the central region (NSC, 1995a). Three out of four provinces in the south are self-sufficient or surplus in rice production due to the fertile plains along the major rivers towards the west of the region. Sekong, an eastern province in the south can not produce enough rice to feed its population due to the unfavourable topography which inhibits the practices of irrigation. The plateau area which extends into this province is not suitable for rice cultivation due to the poor quality of soil and windy conditions.

The questions may be raised as to why in Lao PDR, if one area can produce a surplus of rice and other food supplies, the others still suffer food insecurity and why rice and other food surpluses are not transferred to the deficit areas. The answers to such questions lie in the extremely poor conditions of transport and road networks.

Poor road and transport facilities that exist between and within regions make the transportation of rice and other foodstuffs from the surplus areas to the shortage areas extremely costly and economically unviable. In the rural northern, mountainous and southern plateau areas, intra-regional transportation is so poor that it prevents the affordable and efficient distribution of food to the population in need. Often in the southern plateau, where rice is grown in a very small areas, rice is so costly that people can not buy it throughout the year out of income derived from selling their cash crops, although overall the south is a rice surplus region. Coupled with the scarcity of protein sources in the plateau and the areas beyond the Mekong river and its tributaries in the south, this rice shortage situation is reflected in the high incidence of poverty in the south.

The food availability situation among different population subgroups may not worsened, but has not improved over time (MCHI, 1994). A food security survey conducted in 1995 as a part of the study of the impact of the New Economic Mechanism on the market integration of the rural population in Lao PDR (ANUTECH, 1996) reveals that food insufficiency is a serious problem for population living in the highland zone, lasting up to several months before the new harvest. The situation in the lowland plain is moderately better, but not for the poor households living along flood prone areas. In the lowland plain areas, it is found that there is strong connection between rice shortage and the shortage of labour within households (ANUTECH, 1995: 153-56).

Livestock are raised by Lao people of all ethnic groups, but not normally for consumption except in the urban areas. Large livestock such as cattle and buffaloes are generally regarded as household wealth and would be slaughtered during cultural and religious ceremonies. In rural Laoloum villages cows and buffaloes are consumed

occasionally while for the other ethnic Lao they are slaughtered only for sacrifices. Swine and poultry are often sold for cash income rather seen as a source of protein.

While people in the urban areas can rely on fresh markets for food, fresh markets in most of the rural areas are simply non-existent. Unlike in the rural areas, consumption of eggs and chicken is more common in urban areas. Most villagers in the rural lowland villages regularly derive their protein sources from fish and small animals and insects such as frogs, field rats, birds, snails, locusts and others edible animals. Fish is scarce for people living in the highland zone, except for dried and salted fish imported from the lowland zone. They rely on hunting wildlife as their main source of protein and vegetables as their largest meal component second to rice (Maroczy, 1986; UNICEF, 1992, 1996).

Food availability and consumption in most rural areas of the country fluctuate seasonally. During the production period and prior to the harvest season, large number of households face a rice deficit as well as shortage in other types of protein food; during these times most farmers have very little time to look for other protein sources. The situation is more precarious for people in the highland zone. For most of the time rice is eaten along with fermented salty fish called "*padeak*", together with chili and wild vegetables such bamboo shoot and banana flowers. Little nutrient could be obtained from such a diet.

Malnutrition together with tetanus neonatorum, diarrhoea, measles, malaria and acute respiratory infections is often blamed as an associated cause of under five mortality in the developing world (Cornea, 1989). Protein-energy malnutrition successively leads to reduced activity, weight loss, stunted growth and starvation during an acute episode. Iron-deficiency anaemia induces sluggishness, reduced work

and cognitive performance and reduced resistance to infections. Iodine-deficiency disease (IDD), in the form of goitre and cretinism, provokes reduced growth and diminished intellectual and neurological capacity, whereas vitamin A deficiency causes xerophthalmia or night blindness and total blindness (Cornea, 1989: 166).

The prevalence of stunting among children aged under five in Lao PDR is alarmingly high compared other countries in Asia, ranking from 44 per cent to 47 per cent (World Bank, 1995b: 40; Phanlavong, 1995: 47-48) whereas about 14 per cent of adult Lao suffer chronic energy deficiency (Phanlavong, 1995: 47-48). Lao diet is rich in carbohydrate from rice but poor in protein and other micro nutrients. Iodine, iron and vitamin A deficiency are also reported to pose major health problems for Lao people (Phanlavong, 1995). It is also observed that most Lao women do not know the nutrient values of fruit and green vegetables (Maroczy, 1986).

A series of surveys by the Ministry of Health between the end of 1988 and early 1990 finds that the incidence rate of goitre is 10 per cent for people living in the lowland areas while the corresponding rate for the highland population is 30 per cent (UNICEF, 1992: 65). However, Lao PDR is said to be among countries with the highest rates of iodine deficiency disease (IDD): 95 per cent of the Lao population suffers from various degrees of IDD with 65 per cent severely affected (UNICEF, 1996: 110). In a small survey, it was found that 35 per cent of women in four villages surveyed had anaemia (UNICEF, 1996: 110). In the 1960s, about 94 per cent of household surveyed suffered vitamin A deficiency (Breaky and Vougaropoulos, 1976). Quite a large number of women and children do regularly not eat green-leaf or yellow vegetables and fruits which are important sources of vitamin A.

In sum, no evidence of nutrition improvement is witnessed by Lao PDR (Government of Lao PDR, 1996). For most part of the country during 1990-95 the rice production fluctuates between deficit and surplus. Cereal production even shows a decline since 1980 (NSC, 1995a: 27). Not only is energy- protein deficiency a chronic health problem for the Lao population, micro-nutrient deficiency has also become a threat to the health of women and children and the general population.

8. 5. Health services

The Lao public health system has long been recognized as concentrating only on therapeutic measures not preventive ones (Phomvihane, 1991; MCHI, 1994; World Bank, 1995b). Both modern and traditional medicines are reported to be used concurrently (UNICEF, 1992, MCHI, 1994). Traditional medicines are more widely used by ethnic minorities as the first choice of health care (Phimmasone et al., 1994).

Figures presented in Table 8.2. above show that the population per physician in Lao PDR is among the better ones. However, looking only at the statistic may be grossly misleading, and in reality it is the efficacy and quality of medical personnel, the resources available for them to perform their duties, and finally access by users and levels of utilization that are more important in reducing mortality. During the period from 1976 to 1994, the health service network in Lao PDR has expanded drastically. The number of doctors has increased by about 17 times and physicians by 7 times (NSC, 1995a: 103). The number of hospitals and patient beds has also expanded significantly. However, such dramatic expansion has not produced the expected effect on mortality as the achievements attained are only in quantity, not in quality (Phomvihane, 1991; MCHI, 1994). In public health, as in other fields during the early years of the Lao PDR, it is the figures which matter in the competition for promotion in the party and government administration, not the substance. Therefore with the inflow of aid from the

Eastern bloc economies, new hospitals were established at the provincial levels where there was none before 1975, district hospitals and sub-district dispensaries have been constructed in order to show the population that the new regime cares for their welfare, and students with completed high, lower secondary and primary school education were recruited in large numbers to be trained as doctors, physicians and first-level paramedics respectively. From the mid-1980s to the early 1990s the government's expenditure on the health sector as a percentage of GDP declined. It has begun to grow again since 1992-93, but the increase is mainly from external aid (World Bank, 1995b: 36). The government expenditure on health in 1992-93 was merely 3 per cent of GDP (World Bank, 1995a). Prior to the launching of the New Economic Mechanism, health care was provided free of charge to the general population including some antibiotics and other essential medicines that were available. From the end of the 1980s, though consultations are free, patients have to buy medicines from private suppliers as they are simply not available in the hospital.

In Lao PDR, despite the presence of an extensive network of health facilities, the majority of Lao people mainly turn to self -medication, traditional healers and pharmacies in times of sickness. Both in urban and rural areas, the source of health care that people rely on as their first choice of treatment is the private pharmacy, with a slightly higher proportion of pharmacy users among the urban population despite better access to hospitals in urban areas (MCHI, 1994). Even for diarrhoea and malaria among children, more than 75 per cent of the households in the former case and 55 per cent in the latter case go to pharmacies instead of bringing their children to dispensaries or hospitals . This low utilization of health services stems from many factors, of which the most important are the lack of transport access to the places where

the services are provided, lack of medicines and operating funds, and the low quality or operational failure of the health facilities themselves.

Except for the provincial hospitals which are located at the principal town of each province, it was recently found that out of 117 district hospitals only 20 are fully operational (World Bank, 1995). It is claimed that few resources are available for health facilities and support services below district level, and at the sub-district levels and in rural areas most of the health facilities have not regularly operated for a number of years while the others may be opened only a few days each month (UNICEF, 1992: 136). The majority of district hospitals lack basic facilities such as electricity, latrines, refrigerators or even safe drinking water (World Bank, 1995b). Doctors or trained medical practitioners at the district hospitals or sub-district dispensaries work at most only few hours a day because they have to have time for farming or other income-generating activities. They can not rely on their salaries for their living: their salaries are very low (on average about US. $ 25 a month) and often are not paid on time (UNCEF, 1992). Lack of electricity and the poor transport network and facilities also impede the expansion of the immunization program below the district level, as only a small proportion of Lao PDR is electrified.

During recent times, private health clinics have increased dramatically in numbers and have become an important source of treatment, particularly for the urban population, while private pharmacies and traditional healers remain the most popular sources of health care for the rural population (MCHI, 1994).

Differentials in mortality between population subgroups can also be explained by the differences in access to, and the quality and use of health care services by different groups of people. While 91 per cent of villages in urban areas have access to a

hospital within three kilometres of the village, only 38 per cent of rural villages have that advantage (MCHI, 1994; World Bank, 1995b).

8. 6. Disease environment and sanitation

Malaria is persistently reported to the most important killer in Lao PDR (Maroczy, 1986; UNICEF, 1992; Phanlavong, 1995). Malaria, acute respiratory diseases and diarrhoea are the most important causes of infant and child mortality in Lao PDR (Phanlavong, 1995). For Lao PDR as a whole, natural conditions in most parts of the country favour the transmission of malaria throughout the year (UNICEF, 1992). It was reported that in 1990, the malarial infection rate in three northern provinces was about 17 per cent compared to 52 per cent in the two southern provinces (UNICEF, 1992:56). The Malaria Control Institute under the Ministry of Health estimates that about 3.5 million of the Lao population are at risk of contracting malaria (Phanlavong, 1995: 48).

It has been demonstrated that toilet facilities and a clean water supply are important in lowering mortality (Meegama, 1980; UN, 1982; Peng and Abu Bakar, 1986; Davanzo, 1988; Maganani, 1993). Hygienic and sanitary conditions in Lao PDR are poor especially among rural population and those living in the highland areas. The majority of the households living in the rural areas are without a latrine of any sort, while toilets are only common in the urban areas. It was found that in 1992-93, about 68 per cent of Lao households have no access to any kind of toilet (NSC, 1995b: 72). The situation is believed to be worse among people belong to the other ethnic groups. In one study of three highland villages inhabited by the Other Lao, no hygienic latrines existed (ANUTECH, 1996).

There is a strong correlation between education and the availability of a latrine. Overall, about 90 per cent of population with no education does not have any kind of

latrine, while the corresponding figures are slightly under 70 per cent for people with 1-6 years of education and about 35 per cent for people with more than 7 years of education (MCHI, 1994). This obviously could facilitate the spread of diseases such as parasitic diseases, cholera and dysentery and other water borne diseases. The majority of the Lao people obtain water for general uses and drinking from unprotected wells and natural rivers; and only about 12 per cent of the population have access to tap-water (NSC, 1995b).

With access to safe drinking water supply as seen in Table 8.1, nearly two third of the Lao population is still at risk of contracting water-borne diseases. About 80 to 90 per cent of the rural population must fetch water from rivers, streams or even ponds (UNICEF, 1992:112). Health experts agreed discipline that the poor conditions of hygiene and sanitation, especially in the rural areas of Lao PDR, contribute to the high incidence of diarrhea, water-borne diseases and worm infestations as well as skin, ear and eye infections (UNICEF, 1992: 118). Diarrhea incidence is high among households without toilet facilities (Puffer and Serrano, 1973).

8.7. High fertility

It is commonly found that mortality is high where fertility is high (UN, 1982). It can be seen from Table 8. 2. that fertility in Lao PDR is the highest in the region and so is the percentage of low birth-weighted babies. In Indonesia, China and Vietnam the political and administrative apparatus has been successfully used to help bring about greater use of birth control (McNicoll, 1994). Meanwhile fertility decline in Thailand has been more a result of wide expansion of family planning services and increased levels of socio-economic development and competition in job markets, creating consumerist aspirations and changing the values and costs of children (Knodel et al., 1987). The relationship between birth control and infant and child mortality is probably

a two way flow and they may reinforce one another (Caldwell, 1986). Experience from Western European populations shows a positive relationship between fertility and mortality, though such relation is weak (Palloni, 1990), but reduction in fertility in itself could substantially reduce infant mortality in high fertility societies (UN, 1982: 128).

As described in Chapter 2 and Chapter 5, maternal mortality in Lao PDR is high, around 656 deaths per 100,000 live births (NSC, 1995b; MCHI, 1994), and in societies where fertility is high and modern medical facilities are scanty excess female mortality during childbearing years is to be expected (Gupta, 1995: 8). About 90 per cent of Lao women deliver babies at home, and only 3 per cent of rural women deliver at hospitals (MCHI, 1994). The percentage of women seeking health treatment in cases of having problems with pregnancy and delivery is less than 35 per cent for rural women and the majority of these women do not seek any treatment at all (MCHI, 1994). In the case of Lao females the stress of childbearing is further exacerbated by inadequate nutrition and heavy workloads.

In addition to high fertility, the average interval between births in Lao PDR is found to be usually short(MCHI, 1994). Short intervals between pregnancy outcomes are related to low birth weight through maternal depletion syndrome (Hobcraft et al., 1983). Maternal depletion syndrome is expected among women living in desperate poverty (Winikoff and Castle, 1987). Evidence suggests that low birth- weight babies have poorer survival chances even into childhood (Hobcraft et al, 1983; Koenig et al., 1987). It is therefore possible that the prevailing high fertility rate and high low birth weight percentage in Lao PDR are also responsible for its high level of mortality.

8. 8. Education

Education and especially women's education is widely recognized as the strongest determinant of mortality, in particular infant and child mortality (Caldwell, 1979; 1986; Cleland, 1990; Lindenbaum, 1990). This study is no exception: mother's education was found to be the strongest influence on infant and child mortality in Lao PDR, even at the primary level and controlling for other socio-economic factors. The most prominent common finding from multiple studies is the strong net relationship between adult literacy (particularly female adult literacy) and mortality which holds at all times for all mortality measures (Cleland, 1990: 400-419). The female adult illiteracy rate for Lao PDR is the highest in the region (Table 8.2). Illiteracy is found to be higher among females of other ethnic minorities than for the Laoloum (Maroczy, 1986; UNICEF, 1992; Phimmasone et al., 1994).

The Lao constitution gives equal rights to males and females, and in fact the status of women among the Laoloum is thought to be better than in patriachial societies such as Chinese, Vietnamese or Hmong and Miao-Yao in Laos who still believe in Taoism and confucianism. Among the Laoloum, after marriage a man would move to live into his wife's house for some time before building his own home, and a daughter normally inherits more land than a son. However, probably due to traditional value that the man must be the one who provides economic support in the family, parents in rural areas do not see any economic return on female education. This results in parents discouraging daughters to leave school early or even not to receive education at all (ANUTECH, 1996; World Bank, 1995b).

Nevertheless, as compared to other development areas education in Lao PDR is considered to be a massive success since 1975. Up to 1975 almost 90 per cent of Lao females were illiterate (Sisaliao et al., 1989). During the period following independence

from France in 1954 to 1975, primary schools and hospitals were very limited, existing in major cities only. Education up to high school level existed in Vientiane and Savannakhet only, while lower secondary schools existed in Luangphrabang, Khammuane and Champassack. Tertiary education was located in Vientiane only, and consisted only of teacher training, medical college and law and administration college (Sisaliao et al., 1989). French remained the medium of instruction for education and entry to these high education and secondary schools was very limited, mostly to the sons and daughters of the elite class.

As in the health sector, the number of educational institutions and the number of students have increased tremendously since 1975. The educational sector, however improved in quantity not quality, and often the curricula used were not relevant to the local context or to community needs (Phomvihane, 1991; Somsanit et al., 1995).

Many of the new primary schools in rural areas consist just of scaffolding-like structure and thatched roof without walls, in which two classes have to be conducted simultaneously. Only 44 per cent of schools in rural areas offer complete primary education (World Bank, 1995b: 20). It is reported that in 1991-92, 38 per cent of primary teachers in Lao PDR were not professionally trained teachers, and the dropout rate from primary school was 27 per cent (Somsanit et al., 1995). Therefore, disparities in access to education still exist by sex, economic status and place of residence. Poor rural children are especially disadvantaged (World Bank, 1995b).

8. 8. Cultural factors: housing conditions, health beliefs and cultural practices

Some of these health-related cultural factors were already discussed in general in relation to adult mortality by agro-ecological zone and ethnicity. Cultural, social and behavioural factors are also believed to have influence on infant and child mortality (Scrimshaw, 1978; Caldwell, 1990; Caldwell and Caldwell, 1991).

The general Housing conditions in Lao PDR vary according to ethnicity and urban or rural setting. The differences by ethnic groups are closely related to culture and tradition. As mentioned earlier, the Laoloum live mainly along the lowland plain while the majority of people of other ethnic groups live on the plateaux and mountains. Housing conditions have are believed to be related to mortality conditions, particularly infant and child mortality (Ruzicka et al. 1989; Soeradji and Ismail, 1986; Defo, 1994) and improvements in housing are correlated with mortality decline as in the nineteen century Europe (Burnett, 1991). The same is true in the case of housing and mortality among the Lao people. Burnett (1991) argued that it is beyond dispute that housing is one of the important environmental factors influencing disease and mortality. In examining factors associated with mortality decline in Europe it was found that mortality rates were very high when housing conditions were at their worst in the early industrial towns; when conditions improved during the later nineteenth century, mortality improved significantly (Burnett, 1991: 176). Housing conditions including toilet, water supply facilities, type of kitchen and lighting can presumably affect health largely through their impact on sanitation, thus affecting the incidence of infectious diseases (Kent, 1991: 33).

A typical Laolum house is built on wooden stilts or concrete pillars high enough to let fresh air pass through easily. Walls are generally made of wood or in poorer houses thatched bamboo. Roofs are peaked and the materials vary according to the financial position of the household in question, ranging from simple woven grass or bamboo to iron sheeting and gypsum tiles. Western mansions and concrete town houses are found in the urban centers or large towns, normally owned by better-off households. Given their construction styles, most of the Laoloum houses provide quite good ventilation as compared to other types of houses found in the country.

Housing conditions for people of other ethnic groups depend on their ethnic origin and cultural norms. But two major types of houses are commonly found among these groups. A house belonging to the Laosoung is usually built on the bare ground with pointed roofs made of thatched grass extending almost down to the ground. Stilts are used where there is a need to compensate for the slope. The walls are usually made of wood in a well-to-do village or bamboo in a normal village. A Laosoung house, normally occupied by extended families of a size ranging from over 15 people to 40 people in some cases, has at most one window. There are typically two doors one at each end of the house and no inner side walls to separate kitchen and living quarters from sleeping quarters. Inside the house a short wooden table is raised from the ground next the kitchen for social gatherings and the sleeping quarters are usually made of planks raised above the ground with facades made of fabric or bamboo to separate one family from another. In most cases, houses of people of the Laosoung are over-crowded and lack good ventilation. Quite often animals like pigs, dogs and chickens are allow to roam freely inside the house and mix with children.

A Laotheung house is built on stilts as in the case of Laoloum house but not as tall as in the former case and normally of smaller area. The walls are typically wooden, except among poor households where they are often made of thatched bamboo and roofed with grass. As in the case of the Laoloum people, the Laotheung people live in nuclear families. A Laotheung house generally consists of two rooms: a living quarter together with a kitchen separated from the sleeping quarter by a wall with an entry door. Typically, one window is found on the back side of the sleeping room, but in the houses of some tribes of theLaotheung, the sleeping rooms are without any windows. A Laotheung house, though not as well ventilated as Laoloum houses, seems to allow air

to pass through the house more easily than Laosoung houses, and by being built on stilts it can prevent livestock from entering the house.

Types of houses built by the Other Lao with little or no ventilation at all are the most likely to introduce the risk of respiratory disease from crowding, and indoor air pollution associated with heating and cooking fires, as evidenced in a study of the Hmong in Northern Thailand (Kunstadter and Kunstadter, 1990).

Health beliefs and perception of modern health care vary greatly between Laoloum and the Other Lao. The Other Lao often believe that diseases such as malaria, cholera and high fever are caused by bad spirits rather than by pathogens. To some extent the same belief is also held among the rural villages of Laoloum. For the majority of the Lao population regardless of ethnic origins, particularly those living in the rural and remote areas, there is a general believe that illness is caused by malevolent spirits and must be cured through a certain type ascetic ceremony or sacrifice.

By and large, the majority of Lao people still adhere to a spirit or " *phi*" cult. The vast majority of Laoloum believe in Buddhism which is superimposed on the cult of "*phi*" (Lebar and Suddard, 1960). A substantial number of tribes classified under the broad category of Laoloum are animist particularly among the different tribes of the black and red "Tai" (people who originally inhabited the northeast of Laos and north Vietnam living in mountain valleys), Tainuea, Phunoi, and many other tribes (Chazee, 1994).

In many areas of the country, Laoloum still believe that a human body possess different souls or "*khuan*" which can wander out of the body if the person is harmed by a bad spirit, causing illness, accident or other injury. In such cases a "*khuan*-call back" rite must be performed in conjunction with the cure by traditional healer or by the use of traditional medicines like tree bark, herbs or parts of wild animals such as bear bilus.

However, during recent times, superstition has steadily lost it ground among the Laoloum resulting in their placing more and more reliance on traditional and modern medicines, pharmacies or hospitals where accessible. At present among Laoloum who are of Lao ethnic origin healing by methods of ascetic ritual or animal-based medicines are very rare. Given their relative easier access to modern health care, their main health seeking choices are pharmacy, followed by traditional medicines, receiving treatment at a district or provincial hospital, and consultations with private medical practitioners.

The Other Lao are mostly animist with a very few recently acculturating to Laoloum culture including conversion to Buddhism and to Catholism. The Laosoung are animist and adopt weakened form of ancient Chinese and Confucian and Taoist beliefs with strong emphasis on ancestor spirits. Among these major ethnic groups, in each year there are numerous ritual ceremonies involving the sacrifice of animals such as chickens, pigs and sometime cows. For example, among the Yao people, in each year, at least a "*Khuan* call-back" ceremony must be performed for each member of the household, and in the case of illness ritual ceremonies must be performed separately.

Such beliefs vary in detail from one minority group to the another, but essentially they all are agreed that illness is caused by spirits and must be cured through ceremonies performed by the Shaman and the sacrifice of animals and burning of bamboo paper. Sometimes, in the case of grave sickness, the ceremony can last for many days and becomes very costly as compared the cost of curing by modern medicines. The belief is so strong among some tribes of the Sino-Tibetan group such as the "Iko" group that they regard deformed and multiple births as a bad omen and these babies have to exterminated. In many instances, Iko women are required to give birth in the forest without any assistance. The majority of minority ethnic groups believes that it is the cause of illness that should be addressed, not only the symptoms.

The Laotheung people are essentially animist and believe in a black magic cult (Wall, 1975), but their belief in spirits is somewhat different from the Laosoung. There is no strong connection of spirits to an ancestor cult as in the former case. The spirits are often, in addition to parental spirits, linked to trees, animals, forest, field, and other things. Chazee (1994:65) observes that, among the Mon-kmer, the belief the spirits or genies of things are very active and these spirits are responsible for illness, accidents, natural disasters, suffering and bad harvests. In the case of the outbreak of an epidemic disease or even natural calamity, a buffalo is normally sacrificed to the spirits of ancestors and spirits of the village (Wall, 1975). Other ceremonies using pig and chicken as sacrifices are routinely performed at the end of harvest or at the time a person dies. To cure an illness, most of these people combine the performance of ritual ceremony with the use of magic herbs. Efforts to eradicate the belief in superstition among Lao people have been carried out over a long period. The same kind of campaign for eradication of belief in *"phi"* (spirits) dates back even into ancient history, under the reign of King Phothisarath in 1532 (Vilavong, 1964: 50), and was continued during the period prior 1975 (Lebar and Suddard, 1960; Wall, 1975). However, these efforts produced little effect on the belief of the majority of the population, particularly those living in the rural areas and ethnic minorities. The low level of education among the population and the lack of available and reliable modern health services are likely to continue to contribute to the failure of these campaigns.

Food taboos are generally observed in all groups in Laos, but more seriously the ethnic minorities (Wall, 1975; Breakey and Voulgaropoulos, 1976; UNICEF, 1992). In time of sickness, children are not allowed to eat certain nutritious food such as egg, banana and some types of fish. During delivery, food given to Laoloum mothers just giving birth is restrict to a few types of vegetables such as kalanga, selected fish,

chicken or beef (buffalo meat or other red meat are not allowed), rice, boiled water and salt only. Food taboos among the Other Lao are said to even stricter, even during pregnancy (UNICEF, 1996), but there is little information on this subject.

Regarding personal hygiene, the Laoloum whether in urban or rural areas take baths once or twice daily, while the Laosoung would seldom bath, only once in a week or longer. Cleaning dishes directly after meals is the code of conduct for Laoloum females. It is observed that among many tribes of the Other Lao dishes are left unwashed after meal and often used again in the next meal without being washed. During the time between meals dogs or chickens may enter the house and dirty the dishes. This practice undoubtedly facilitates the spread of bacterial and parasitic diseases.

8. 9. Policy implications

The foregoing description throws light on the mortality situation in Lao PDR and its determinants and possible correlates. In general, the economic and social infrastructure, particularly primary health care, education, sanitation, safe water supply necessary for to low mortality remain underdeveloped. Disparity in the availability and quality of health care and in access to both it other social services, especially between urban and rural populations which are primary forces behind high mortality regime observed. Additional causes are inadequacy in food supply and nutrient intakes, low productivity and low level of education, high fertility and close birth spacing, traditional beliefs and cultural practices and ignorance which is ultimately linked to poverty.

To bring about mortality decline multi-faceted programs that involve the whole community are needed. Programs should integrate areas such as ensuring food security and nutritional intakes by improving the existing extension services; and promoting agricultural diversification in order to broaden the income base of the rural population

so as to enable the purchase of rice where local production is not sufficient; educating people about nutritional values and food handling, as many kind of legumes and vegetables rich in protein and vitamin are readily available in the vicinity of most villages without any additional cost to households. Animal production and consumption should be strongly promoted by providing extension services and vaccines at low prices. As important sources of food and income for the rural population, forests and watershed must be preserved. Illegal logging must be ended. Construction of hydro-electric dam for exportation should take this into consideration.

Present quality of health services must be improved by allocating more funds to public health, concentrating on preventive measures and primary health care instead of spending more than half of the annual health budget on the expensive hospital-based therapeutic measures. Mortality can be reduced substantially if antenatal and postnatal health care and immunization against major diseases are expanded beyond the present level. Local women should recruited on a voluntary basis to be trained as birth attendants and sent back to their villages. These women would have other kinds of economic activities, but may charge small fee when providing services to people in their own villages. This would greatly reduce perinatal and neo-natal mortality.

Development programs should also stress the provision of safe drinking water using low-cost technology and sanitation by promoting the use of latrines even the most rudimentary ones such as pit toilet.

Educational policies should be designed to keep girls in school as long as possible. This study and numerous other studies prove that female education is a very strong determinant of health and mortality. Universal education should be the target and population aspects including personal hygiene and basic health care must be part of the curriculum. Informal means of educating people about the benefit of immunization,

sanitation and hygiene in the form of easily understandable posters and leaflets should be used. Information dissemination on health issues should also draw on the Lao Women's Union and the Lao Youth Federation which have extensive structures down to the grass root level. This kind of education should also point out to the population about the deleterious health aspects of superstition and some cultural practices and the benefit of modern health care and education. Most importantly, the quality of formal education should be revised and improved in the light of fast changing economic and job competition circumstances and the need for relevance to local circumstances.

Guidelines should be established for the regulation of pharmacists in order to ensure that the correct medicines are sold to the population and proper consultations are given. Information and supplies from pharmacies are the largest sources of treatment that people use.

To bring down fertility and realize the consequent health benefits for mothers and children family planning programs such as the present birth spacing program must be expanded. Cost recovery approaches should not be put in place too early as this may discourage potential users in a setting where cash income is scarce. In the face of financial constraints, international assistance in this area must be sought and a sustainable approached developed.

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APPENDIX TABLES

Table A.2.1 : Percentage distribution of population by sex, and sex, MVSS sample, Round 1 and the 1995 population census.

Age	MVSS Sample		MVSS subset		1995 Census		Sex ratios	
	Male	Female	Male	Female	Male	Female	MVSS subset	1995 census
5-9	16.0	14.5	17.5	15.4	15.7	14.8	1.05	1.04
10-14	13.6	12.3	14.4	12.9	13.8	12.7	1.03	1.06
15-19	9.3	10.1	8.2	9.1	9.9	10.0	0.83	0.96
20-24	5.5	8.2	4.3	7.4	7.5	8.4	0.53	0.87
25-29	6.8	7.7	6.1	7.6	7.1	7.8	0.73	0.90
30-34	5.4	5.6	5.4	5.9	6.1	6.2	0.85	0.95
35-39	5.5	5.1	5.7	5.4	5.9	5.7	0.96	1.01
40-44	3.4	3.5	3.7	3.8	4.0	3.9	0.90	0.99
45-49	3.7	3.8	4.0	4.2	3.4	3.5	0.88	0.95
50-54	2.9	3.2	3.3	3.6	2.7	3.1	0.84	0.83
55-59	3.0	2.8	3.3	3.1	2.3	2.4	0.99	0.94
60-64	2.2	2.1	2.5	2.2	1.9	2.0	1.02	0.92
65-69	1.9	1.5	2.1	1.6	1.5	1.5	1.20	1.01
70-74	0.9	1.1	1.0	1.1	1.0	1.0	0.85	0.90
75+	1.3	1.5	1.4	1.6	1.1	1.3	0.81	0.83
Total	48468	52741	47548	51670	2260986	2313862		

Source: Preliminary analysis of MVSS subset; 1995 Census data are obtained from a fascimile sheet sent by the National Statistical Centre, Vientiane, Lao PDR.

Table A.2.2. Estimated number of population and deaths for MVSS sample subset, by sex, 1990.

Age	Population		No. of deaths	
	Male	Female	Male	Female
5-9	8666	8205	65	80
10-14	7067	6813	31	29
15-19	4640	5145	21	19
20-24	2206	4000	15	29
25-29	2645	3904	22	24
30-34	2738	3307	17	24
35-39	2602	2724	17	17
40-44	2043	2177	11	16
45-49	1751	2024	19	21
50-54	1646	1955	30	33
55-59	1527	1578	33	26
60-64	1263	1252	39	25
65-69	1004	839	33	23
70-74	580	639	30	34
75+	685	838	59	67

Source: Preliminary analysis of MVSS subset

Note: Population is the mean of population at the beginning and the end, P = (P1+P4)/2
Deaths are the average annual deaths calculated from deaths occurred in the 18 month period.

Table A.3.1: Data for the estimation of ${}_nq_x$, 1965-1994, FBSS, 1994, Lao PDR

Interval in month	Number of censored cases	Number of exposed to risk	Number of terminal events (deaths)	Proportion terminating during the interval ${}_nq_x$	Proportion surviving l(x)
0-11	1428	22555	2816	0.1249	0.8751
12-59	5188	16431	1152	0.0701	0.8138
60 + *	12209	6580	476	0.0723	0.7549

* Calculation of the last interval has no meaning.
Total valid cases: 23269, Missing case: 0.
Source: FBSS , excerpt from the *SPSS* survival's life table procedure output.

Table A.3.2: Data for the estimation of ${}_nq_x$,1965-1994, FBSS, by sex

Interval in month	Number entering this interval	Number of censored cases	Number of exposed to risk	Number of terminal events (deaths)	Proportion terminating during the interval ${}_nq_x$	Proportion surviving l(x)
Males						
0	11953	742	11582	1561	0.1348	0.8652
12	9650	2607	8346	584	0.0700	0.8047
60 + *	6459	6216	3351	234	0.0725	0.7463
Females						
0	11316	686	10973	1255	0.1144	0.8856
12	9375	2581	8084	568	0.0703	0.8234
60+ *	6226	5993	3229	233	0.0721	0.7640

* Calculation in the last interval has no meaning.
Total valid cases: 23269, Missing case: 0.
Source: FBSS , excerpt from the *SPSS* survival's life table procedure output.

Table A.3.3. Data for the estimation of ${}_nq_x$,1965-1994, FBSS, by birth cohort

Interval in month	Number entering this interval	Number of censored cases	Number of exposed to risk	Number of terminal events (deaths)	Proportion terminating during the interval ${}_nq_x$	Proportion surviving l(x)
1990-94						
0	7089	1428	6375	776	0.1217	0.8783
12	4885	4712	2529	170	0.0672	0.9328
60 + *	3	0	3	3	1.0000	0.0000
1985-89						
0	6705	0	6705	795	0.1186	0.8814
12	5910	476	5672	378	0.0666	0.8227
60+ *	5056	4967	2572	89	0.0346	0.7942
1980-84						
0	4961	0	4961	602	0.1213	0.8787
12	4359	0	4359	301	0.0691	0.8180
60+ *	4058	3931	2092	127	0.0607	0.7683
1975-79						
0	2786	0	2786	387	0.1389	0.8611
12	2399	0	2399	189	0.0788	0.7933
60+ *	2210	2067	1176	143	0.1215	0.6968
1970-74						
0	1285	0	1285	174	0.1354	0.8646
12	1111	0	1111	90	0.0810	0.7946
60+ *	1021	938	552	83	0.1540	0.6751
<1970						
0	443	0	443	82	0.1851	0.8149
12	361	0	361	24	0.0665	0.7607
60+ *	337	306	184	31	0.1685	06326

* Calculation in the last interval has no meaning.
Total valid cases: 23269, Missing case: 0.
Source: FBSS , excerpt from the *SPSS* survival's life table procedure output.

Table A.4.1. Definitions of life table columns

The following are the meaing of each of life table columns in Table 4.1 and 4. 2, Chapter 4 :

l(x) = number of persons alive at exact age x in the life table population. l(0), known as the life table radix is conventionally set at 100000.

q(x) = the estimated probability of dying at age x before reaching age x+5.

q(x) = 5 . M(x)/ [1+2.5M(x)], where M(x) is age-specific mortality rates for age interval (x, x+5).

d(x) = number of persons who die between age x and x+5 out of an original cohort 100000.

$$d(x) = l(x) - l(x+5)$$

p(x)= probability of surviving from exact age x to x+5.

$$p(x) = 1 - q(x)$$

L(x) = number of person-years lived between age x and x+5 by an original cohort of 100000.

$$L(x) = 2.5[l(x)+l(x+5)]$$

$$L(0) = 0.276\, l(x) + 0.724\, l(1); \text{ and } L(4) = 1.9\, l(1) + 2.1\, l(4)$$

T(x) = number of person-years lived at exact age x and above by an original cohort of 100000.

$$T(x) = L(x) + \ldots\ldots + L(w), \text{ where w is the last age interval.}$$

e(x) = expected number of years that a person who reaches exact age x will live or life expectancy at age x.

$$e(x) = T(x) / l(x)$$

Table A.5.1. Number of population, deaths and age-specific death rates, per1000 persons, males, by agro-ecological zone, Lao PDR, 1990.

Age group	Population		Deaths		$_nM_x$	
	Lowland	Highland	Lowland	Highland	Lowland	Highland
5-9	4914	3752	29	36	5.834	9.595
10-14	4218	2849	9	22	2.055	7.723
15-19	2835	1805	8	13	2.822	7.389
20-24	1322	884	7	9	5.043	9.804
25-29	1448	1197	11	11	7.827	8.911
30-34	1499	1240	9	8	6.228	6.454
35-39	1473	1129	7	9	4.980	8.267
40-44	1176	868	5	5	4.537	6.148
45-49	1003	748	7	11	7.311	15.162
50-54	947	699	19	11	20.426	15.271
55-59	871	656	19	15	21.431	22.375
60-64	690	573	17	22	24.172	38.394
65-69	562	442	19	14	34.401	31.674
70-74	307	274	13	17	41.327	63.376
75+	393	292	34	25	86.514	86.907

Source: The MVSS sample sub-set, Lao PDR, 1990.

Table A.5.2. Number of population, deaths and age-specific death rates, per1000 persons, females, by agro-ecological zone, Lao PDR, 1990.

Age group	Population		Deaths		$_nM_x$	
	Lowland	Highland	Lowland	Highland	Lowland	Highland
5-9	4639	3567	39	41	8.336	11.589
10-14	4021	2792	15	14	3.648	5.014
15-19	3147	1999	9	11	2.754	5.337
20-24	2413	1587	13	16	5.250	10.082
25-29	2215	1689	9	15	4.215	8.686
30-34	1842	1465	16	8	8.686	5.461
35-39	1597	1128	9	7	5.846	6.504
40-44	1207	970	6	10	4.971	10.315
45-49	1168	857	11	9	9.707	10.897
50-54	1157	798	15	17	13.258	21.721
55-59	890	688	13	13	14.981	18.411
60-64	696	557	12	13	17.254	22.761
65-69	484	355	12	11	24.793	31.970
70-74	357	282	17	17	48.553	59.207
75+	507	331	37	30	73.708	90.634

Source: The MVSS sample sub-set, Lao PDR, 1990.

Table A.5.3. Number of population, deaths and age-specific death rates, per1000 persons, males, by region, Lao PDR, 1990.

Age group	Population			Number of deaths			${}_nM_x$		
	North	Centre	South	North	Centre	South	North	Centre	South
5-9	3130	3420	2116	26	19	20	8.307	5.458	9.454
10-14	2382	2953	1732	17	5	8	7.277	1.806	4.620
15-19	1467	2071	1103	10	7	5	6.819	3.219	4.233
20-24	696	1088	423	7	3	5	10.544	3.065	11.032
25-29	970	1110	566	10	7	5	10.315	6.006	9.431
30-34	1041	1146	552	7	7	3	7.048	6.402	4.831
35-39	967	1038	597	11	3	3	11.036	3.211	4.467
40-44	745	817	482	3	7	1	3.582	8.165	2.766
45-49	636	713	403	9	8	2	13.638	11.228	4.969
50-54	579	666	402	10	15	5	17.286	23.040	11.609
55-59	553	597	377	15	13	5	27.728	21.235	14.166
60-64	467	499	297	14	15	10	30.011	29.392	33.727
65-69	393	357	254	15	12	6	39.016	33.613	23.622
70-74	242	191	148	14	11	5	57.971	55.993	36.036
75+	267	253	165	23	25	11	84.894	100.330	68.687

Source: The MVSS sample sub-set, Lao PDR, 1990.

Table A.5.4. Number of population, deaths and age-specific death rates, per1000 persons, females, by region, Lao PDR, 1990.

Age group	Population			Deaths			${}_nM_x$		
	North	Centre	South	North	Centre	South	North	Centre	South
5-9	3055	3212	1939	27	25	28	8.730	7.888	14.444
10-14	2329	2816	1668	13	7	9	5.725	2.368	5.196
15-19	1654	2235	1257	7	5	8	4.031	2.088	6.367
20-24	1229	1790	981	11	11	7	8.683	6.331	6.796
25-29	1378	1645	882	13	7	5	9.195	4.054	5.291
30-34	1225	1301	781	10	9	5	8.163	6.662	6.829
35-39	923	1108	694	6	4	7	6.501	3.612	9.613
40-44	764	818	595	8	6	2	10.478	7.335	3.361
45-49	727	767	531	7	9	5	10.094	11.299	8.797
50-54	659	777	519	13	13	7	20.248	16.302	12.845
55-59	595	569	414	11	9	6	17.927	16.403	14.493
60-64	462	458	333	11	9	4	24.558	20.401	12.012
65-69	325	293	222	9	6	9	26.708	20.513	39.127
70-74	266	208	165	18	9	7	67.669	41.767	44.444
75+	297	309	232	30	19	19	101.180	60.410	80.460

Source: The MVSS sample sub-set, Lao PDR, 1990.

Table A.5.5. Number of population, deaths and age-specific death rates, per1000 persons, males, by urban-rural place of residence, Lao PDR, 1990.

Age group	Population		Deaths		$_nM_x$	
	Urban	Rural	Urban	Rural	Urban	Rural
5-9	2027	6639	7	57	3.619	8.636
10-14	1695	5372	5	26	2.754	4.840
15-19	1165	3475	5	17	4.006	4.796
20-24	626	1580	3	13	4.260	8.017
25-29	636	2010	2	20	3.147	9.953
30-34	674	2064	5	12	7.913	5.814
35-39	644	1958	2	15	3.106	7.493
40-44	495	1549	1	9	2.696	6.027
45-49	412	1339	5	14	11.327	10.459
50-54	343	1303	6	24	17.493	18.419
55-59	337	1190	9	24	27.695	20.177
60-64	287	976	7	32	23.269	32.787
65-69	226	779	11	23	47.302	29.116
70-74	129	451	5	25	41.344	54.693
75+	142	543	15	45	103.651	82.259

Source: The MVSS sample sub-set, Lao PDR, 1990.

Table A.5.6. Number of population, deaths and age-specific death rates, per1000 persons, females, by urban-rural place of residence, Lao PDR, 1990.

Age group	Population		Deaths		${}_nM_x$	
	Urban	Rural	Urban	Rural	Urban	Rural
5-9	1905	6300	8	72	4.199	11.429
10-14	1613	5199	3	25	2.067	4.873
15-19	1285	3860	1	19	0.519	4.836
20-24	1016	2984	5	24	4.595	8.043
25-29	981	2924	1	23	1.360	7.753
30-34	848	2460	5	19	5.506	7.861
35-39	623	2101	1	15	2.140	7.298
40-44	471	1706	3	13	7.077	7.427
45-49	429	1596	3	17	7.779	10.864
50-54	396	1559	6	27	15.171	17.105
55-59	351	1227	6	20	17.094	16.300
60-64	277	976	6	19	21.700	19.135
65-69	190	649	3	20	17.590	30.817
70-74	140	499	8	26	57.348	52.104
75+	179	659	18	49	100.559	74.918

Source: The MVSS sample sub-set, Lao PDR, 1990.

Table A.5.7. Number of population, deaths and age-specific death rates, per1000 persons, males, by ethnic group, Lao PDR, 1990.

Age group	Population		Deaths		$_nM_x$	
	Laoloum	Other Lao	Laoloum	Other Lao	Laoloum	Other Lao
5-9	6845	1821	47	17	6.915	9.521
10-14	5654	1413	22	9	3.891	6.136
15-19	3706	935	13	9	3.418	9.274
20-24	1666	541	11	5	6.404	8.634
25-29	2032	613	13	9	6.562	14.138
30-34	2087	651	12	5	5.750	8.193
35-39	2023	579	10	7	4.943	11.524
40-44	1596	448	7	4	4.178	8.939
45-49	1338	413	15	3	11.460	8.081
50-54	1293	354	23	7	17.537	20.745
55-59	1233	294	23	11	18.391	36.281
60-64	1006	257	27	11	27.184	44.099
65-69	806	199	28	5	34.761	26.868
70-74	441	139	21	9	48.375	62.350
75+	533	152	45	14	85.133	92.105

Source: The MVSS sample sub-set, Lao PDR, 1990.

Table A.5.8. Number of population, deaths and age-specific death rates, per1000 persons, females, by ethnic group, Lao PDR, 1990.

Age group	Population		Deaths		${}_nM_x$	
	Laoloum	Other Lao	Laoloum	Other Lao	Laoloum	Other Lao
5-9	6453	1752	56	24	8.678	13.699
10-14	5462	1351	17	12	3.052	8.882
15-19	4169	976	12	7	2.878	7.514
20-24	3164	836	20	9	6.322	10.367
25-29	3051	853	15	9	4.807	10.942
30-34	2521	786	17	7	6.611	9.330
35-39	2154	571	10	7	4.644	11.686
40-44	1664	513	10	6	6.011	11.696
45-49	1587	438	18	3	11.346	6.095
50-54	1494	461	22	11	14.730	23.138
55-59	1256	322	21	5	16.454	16.563
60-64	963	289	18	7	18.692	23.068
65-69	694	145	16	7	23.055	50.750
70-74	502	137	25	9	50.515	63.260
75+	666	172	57	11	85.085	62.196

Source: The MVSS sample sub-set, Lao PDR, 1990.

Table A.6.1. Data for the estimation of ${}_nq_x$,1965-1994, FBSS, by mother's age at childbirth

Interval in month	Number entering this interval	Number of censored cases	Number of exposed to risk	Number of terminal events (deaths)	Proportion terminating during the interval ${}_nq_x$	Proportion surviving l(x)
<20 years old						
0	3904	138	3835	709	0.1849	0.8151
12	3057	593	2761	204	0.0739	0.7549
60 + *	2260	2141	1189	119	0.1000	0.6794
20-24 years old						
0	7666	360	7486	927	0.1238	0.8762
12	6379	1417	5670	389	0.0686	0.8161
60+ *	4573	4383	2381	190	0.0798	0.7510
25-29 years old						
0	6083	397	5884	606	0.1030	0.8970
12	5080	1429	4365	311	0.0712	0.8331
60+ *	3340	3230	1725	110	0.0638	0.7800
30-34 years old						
0	3591	280	3451	366	0.1061	0.8939
12	2945	983	2453	173	0.0705	0.8309
60+ *	1789	1740	919	49	0.0533	0.7866
35-39 years old						
0	1567	186	1474	152	0.1031	0.8969
12	1229	547	955	61	0.0638	0.8396
60+ *	621	614	314	7	0.0223	0.8209
40 years and over						
0	458	67	425	56	0.1319	0.8681
12	335	219	226	14	0.0621	0.8142
60+ *	102	101	52	1	0.0194	0.7984

* Calculation in the last interval has no meaning.
Total valid cases: 23269, Missing case: 0.
Source: FBSS , excerpt from the *SPSS* survival's life table procedure output.

Table A.6.2. Data for the estimation of ${}_nq_x$,1965-1994, FBSS, by birth order

Interval month	Number entering this interval	Number of censored cases	Number of exposed to risk	Number of terminal events (deaths)	Proportion terminating during the interval ${}_nq_x$	Proportion surviving l(x)
1st order						
0	5440	215	5333	768	0.1140	0.8560
12	4457	953	3981	209	0.0525	0.8110
60 + *	3295	3139	1725	156	0.0904	0.7377
2nd –3rd order						
0	8417	466	8184	942	0.1151	0.8849
12	7009	1636	6191	434	0.0701	0.8229
60+ *	4939	4777	2550	162	0.0635	0.7706
4th-5th order						
0	5122	310	4967	556	0.1119	0.8881
12	4256	1314	3599	284	0.0789	0.8180
60+ *	2658	2553	1381	105	0.0760	0.7558
6th order and more						
0	4290	437	4072	550	0.1351	0.8649
12	3303	1285	2661	225	0.0846	0.7918
60+ *	1793	1740	923	53	0.0574	0.7463

* Calculation in the last interval has no meaning.
Total valid cases: 23269, Missing case: 0.
Source: FBSS , excerpt from the *SPSS* survival's life table procedure output.

Table A.6.3. Data for the estimation of ${}_nq_x$,1965-1994, FBSS, by region

Interval in month	Number entering this interval	Number of censored cases	Number of exposed to risk	Number of terminal events (deaths)	Proportion terminating during the interval ${}_nq_x$	Proportion surviving l(x)
North						
0	5942	356	5764	694	0.1204	0.8796
12	4892	1430	4177	364	0.0871	0.8029
60 + *	3098	2962	1617	136	0.0841	0.7354
Centre						
0	12778	801	12377	1572	0.1270	0.8730
12	10405	2704	9053	588	0.0650	0.8163
60+ *	7113	6870	3678	243	0.0661	0.7624
South						
0	4549	271	4413	550	0.1246	0.8754
12	3728	1054	3201	200	0.0625	0.8207
60+ *	2474	2377	1285	97	0.0755	0.7588

* Calculation in the last interval has no meaning.
Total valid cases: 23269, Missing case: 0.
Source: FBSS , excerpt from the *SPSS* survival's life table procedure output.

Table A.6.4. Data for the estimation of ${}_nq_x$,1965-1994, FBSS, by urban-rural residence

Interval month	Number entering this interval	Number of censored cases	Number of exposed to risk	Number of terminal events (deaths)	Proportion terminating during the interval ${}_nq_x$	Proportion surviving l(x)
Urban						
0	4670	240	4550	357	0.0785	0.9215
12	4073	998	3574	98	0.0274	0.8963
60 + *	2977	2918	1518	59	0.0389	0.8614
Rural						
0	18599	1188	18005	2459	0.1366	0.8634
12	14952	4190	12857	1054	0.0820	0.7926
60+ *	9708	9291	5062	417	0.0824	0.7274

* Calculation in the last interval has no meaning.
Total valid cases: 23269, Missing case: 0.
Source: FBSS , excerpt from the *SPSS* survival's life table procedure output

Table A.6.5. Data for the estimation of ${}_nq_x$,1965-1994, FBSS, by maternal education

Interval in month	Number entering this interval	Number of censored cases	Number of exposed to risk	Number of terminal events (deaths)	Proportion terminating during the interval ${}_nq_x$	Proportion surviving l(x)
None						
0	10890	561	10609	1629	0.1535	0.8465
12	8700	2069	7665	698	0.0911	0.7694
60 + *	5933	5641	3112	292	0.0938	0.6972
Primary						
0	9013	585	8720	949	0.1088	0.8912
12	7479	2092	6433	394	0.0612	0.8366
60+ *	4993	4837	2574	156	0.0606	0.7859
Above primary						
0	3366	282	3225	238	0.0738	0.9262
12	2846	1027	2332	60	0.0257	0.9024
60+ *	1759	1731	893	28	0.0313	0.8741

* Calculation in the last interval has no meaning.
Total valid cases: 23269, Missing case: 0.
Source: FBSS , excerpt from the *SPSS* survival's life table procedure output.

Table A.6.6. Data for the estimation of ${}_nq_x$,1965-1994, FBSS, by paternal education

Interval in month	Number entering this interval	Number of censored cases	Number of exposed to risk	Number of terminal events (deaths)	Proportion terminating during the interval ${}_nq_x$	Proportion surviving l(x)
None						
0	5555	296	5407	860	0.1591	0.8409
12	4399	1083	3857	364	0.0944	0.7616
60 + *	2952	2818	1543	134	0.0868	0.6955
Primary						
0	10586	659	10256	1376	0.1342	0.8658
12	8551	2309	7396	579	0.0783	0.7981
60+ *	5663	5421	2952	242	0.0820	0.7327
Above primary						
0	7128	473	6892	580	0.0842	0.9158
12	6075	1796	5177	209	0.0404	0.8789
60+ *	4070	3970	2085	100	0.0480	0.8367

* Calculation in the last interval has no meaning.
Total valid cases: 23269, Missing case: 0.
Source: FBSS , excerpt from the *SPSS* survival's life table procedure output.

Table A.6.7. Data for the estimation of ${}_nq_x$,1965-1994, FBSS, by mother's occupation

Interval in month	Number entering this interval	Number of censored cases	Number of exposed to risk	Number of terminal events (deaths)	Proportion terminating during the interval ${}_nq_x$	Proportion surviving l(x)
Farmers						
0	16807	1024	16295	2195	0.1347	0.8653
12	13588	3718	11729	933	0.0795	0.7965
60 + *	8937	8579	4647	358	0.0770	0.7351
Public servants						
0	645	52	619	49	0.0792	0.9208
12	544	199	445	11	0.0247	0.8981
60+ *	334	334	167	0	0.0000	0.8981
Trade and others						
0	5817	352	5641	572	0.1014	0.8986
12	4893	1271	4258	208	0.0489	0.8547
60+ *	3414	3296	1766	118	0.0668	0.7976

* Calculation in the last interval has no meaning.
Total valid cases: 23269, Missing case: 0.
Source: FBSS , excerpt from the *SPSS* survival's life table procedure output.

Table A.6.8. Data for the estimation of ${}_nq_x$,1965-1994, FBSS, by father's occupation

Interval in month	Number entering this interval	Number of censored cases	Number of exposed to risk	Number of terminal events (deaths)	Proportion terminating during the interval ${}_nq_x$	Proportion surviving l(x)
Farmers						
0	18289	1131	17723	2410	0.1360	0.8640
12	14748	4016	12740	1028	0.0807	0.7943
60 + *	9704	9287	5060	417	0.0824	0.7289
Labour and others						
0	1729	101	1678	136	0.0810	0.9190
12	1492	397	1293	45	0.0348	0.8870
60+ *	1050	1027	536	23	0.0429	0.8490
Public servants						
0	2304	150	2229	175	0.0785	0.9215
12	1979	595	1682	43	0.0256	0.8979
60+ *	1341	1318	682	23	0.0337	0.8676
Trade and other professionals						
0	947	46	924	95	0.1028	0.8972
12	806	180	716	36	0.0503	0.8521
60+ *	590	577	302	13	0.0431	0.8153

* Calculation in the last interval has no meaning.
Total valid cases: 23269, Missing case: 0.
Source: FBSS , excerpt from the *SPSS* survival's life table procedure output.